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ECONOMIC GEOGRAPHY

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JANUARY

MEXICO'S FOOT-AND-MOUTH DISEASE PROBLEM
Earl B. Shaw

WHEAT PRODUCING AREAS IN PERU
Marjorie Smith Sommers

URBAN SETTLEMENT IN HOKKAIDO
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POPULATION OF THE MANOR COUNTIES OF MARYLAND
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EROSION IN A WISCONSIN DAIRY COMMUNITY
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RESOURCES OF THE DUGWAY AREA, UTAH
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FLORIDA'S CLIMATIC EXTREMES: COLD SPELLS AND FREEZES
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THE MANOR COUNTIES

THE Manor Counties of Maryland form one of the most distinctive and gracious communities in America. There the climate is hospitable, terrain comfortable, soils fertile and highly productive, resources varied and adequate, and the countryside peaceful and attractive. There, in the midst of plenty and prosperity, folk have learned long since the art of living abundantly and graciously, of entertaining delightfully, and enjoying to the fullest the loveliness and bounty of the land in which they live. There, American citizenship and patriotism have achieved a perfection that might well be envied and emulated throughout our country.

From the deep, fertile soils of the farms on the rolling terrain of the lower Piedmont, farmers take heavy yields of wheat, and corn, and alfalfa; on the luxuriant pastures they raise prize-winning cattle, swine and sheep; in their productive orchards all kinds of luscious temperate fruits flourish and yield heavily and trustworthily; in their gardens they can grow any and all healthful vegetables; from the shallow, mild waters of the neighboring bay, they take varied fishes and oysters and crabs; from the streams they get shad and smelt and other finfish; wild fowl throng the marshes and bays, quail and pheasant find cover in the broom-sedge and cut-over woodlands, squirrel and rabbit and raccoon haunt the brush and groves.

It is a land of rich and abundant living where tournaments, races, and riding after the hounds, enliven the days of toil. It is a land of fun and recreation as well as of industry and application to business. It is a land of superior transportation facilities, of capacious homes, of flourishing agriculture, and alluring landscape. It is a land of content and charm, as well as of vision and achievement. Men and women who dwell there, or who have been born and nurtured there, have made deep impress upon the institutions and history of America. The Manor Counties of Maryland grace America's rural life.

ECONOMIC GEOGRAPHY

VOL. 25 JANUARY, 1949 NO. 1

MEXICO'S FOOT-AND-MOUTH DISEASE PROBLEM

Earl B. Shaw

THE influence of plant and animal diseases upon man and his activities has long been of interest to students of geography. Leadership in production of several of the world's major commodities has passed from one country to another because of the inroads of disease. For years our relations with Argentina have been disturbed because of trade disagreements brought about by foot-and-mouth disease. This same infection has already cost Mexico and the United States millions of dollars (Figures 1 and 2), not only to protect Mexican livestock but also to safeguard our own industry, which, according to M. R. Clarkson, In Charge Inspection and Quarantine Division, United States Department of Agriculture, Bureau of Animal Industry, contributes over thirteen billion dollars to our annual income. The purpose of this study is to show progress made in fighting the spread of the malady, to point out effects upon Mexican–United States cattle trade, and to consider future policies likely to be followed by the United States Department of Agriculture in protecting American livestock.

Foot-and-mouth disease is one of the most contagious and widespread diseases attacking cloven-footed animals. It is found now on every inhabited continent except Australia. Caused by a filterable virus, it results in heavy losses in the acute stages and lowers production of meat and milk from animals that survive. Blisters appear in the mouth, and the affected animal suffers from excessive salivation (Figure 3), high fever and severe lameness. Animals sometimes lose the outer hoof completely, and if they walk at all, do so with extreme difficulty. (For a more detailed description of the disease see United States Department of Agriculture, Farmers' Bulletin No. 666; also Shaw, Earl B., "United States Restrictions on Argentine Beef," *The Scientific Monthly*, August 1945, pp. 101–8.)

An established policy of the United States Department of Agriculture is to exclude foot-and-mouth disease by rigid quarantine; and, in coöperation with state governments, to suppress by prompt slaughter (Figure 4) of affected and exposed animals and by other effective means, any outbreaks that may occur. It is also the Department's policy to coöperate with officials of other countries in controlling foreign epidemics and by so doing remove the menace to flocks and herds within our own borders.

In a treaty enacted between the United States and Mexico in January 1930, the two nations arranged to prohibit importation of ruminants and swine from countries where foot-and-mouth disease exists. (For complete details on the treaty see Treaty Series No. 808, "Convention between the United States and Mexico," Safeguarding Livestock Interests Through the

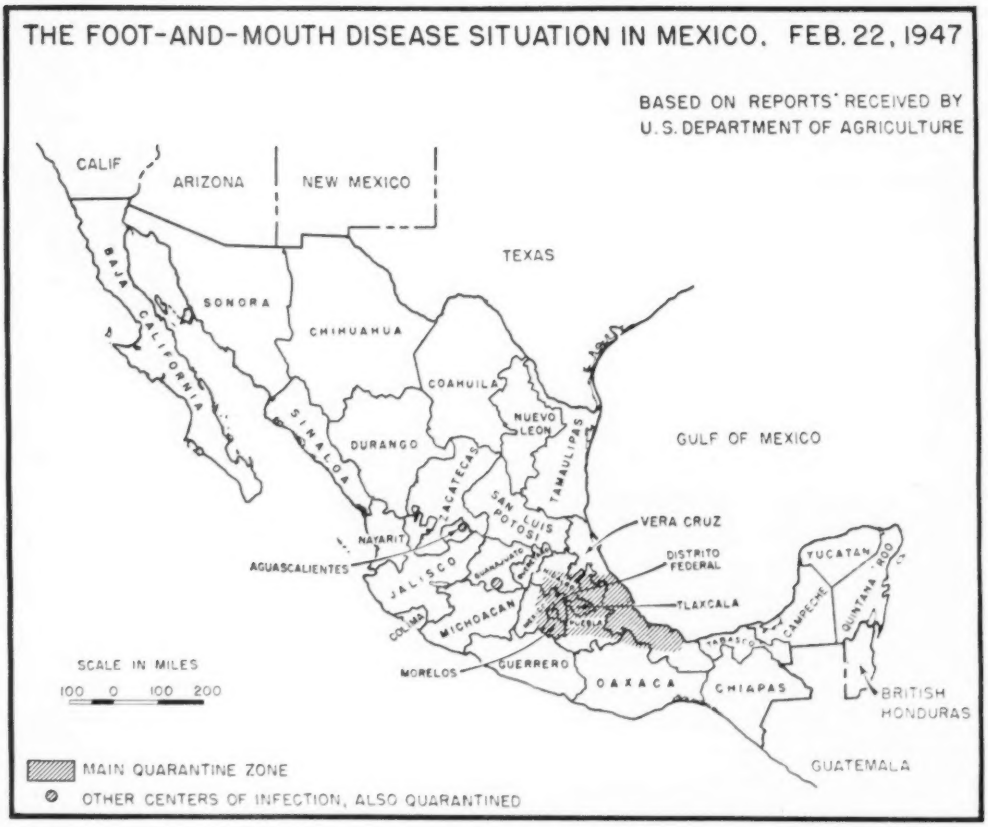

FIGURE 1.—Map of February 22, 1947 showing the infected area less than two months after veterinarians pronounced the Vera Cruz epidemic foot-and-mouth disease. (Courtesy U. S. Dept. of Agriculture.)

Prevention of Infectious and Contagious Diseases.) In spite of the treaty, Mexico, during October 1945 and early in 1946, permitted entry of two consignments of zebu cattle (Figure 5) from Brazil, where foot-and-mouth disease is known to exist. The United States Department of Agriculture, with the coöperation of the State Department, protested strongly against the shipments, taking the position that they were in violation of the treaty, and that they endangered the livestock industries of the two countries. As protests were unavailing, movement of cattle into the United States was restricted by quarantine, effective June 5, 1946. On September 1, 1946, however, two United States veterinarians and two from Mexico began a survey of districts where animals included in the Brazilian shipments were located. This survey was completed October 14, 1946, and the report listed no evidence of foot-and-mouth disease. As a consequence, the June 5 quarantine was revoked effective October 18. A political reason for lifting the quarantine on October 18 was suggested by the *Chicago Tribune*. In the issue of December 31, 1946, the following statement was included: "President Truman opened the borders for the importation of Mexican cattle in mid-October when urged by Democratic politicians to end the meat famine before the November elections. He said at the time he had been assured by Agriculture Secretary Anderson, who

was busy making political speeches, that it would be sanitarily safe to do so. Senator Brooks, Republican from Illinois, has announced he will ask senate investigation of charges that the import bans were lifted under political pressure."

On December 18, 1946, the United States Department of Agriculture received word of an outbreak of cattle sickness in Veracruz with foot-and-mouth disease symptoms. Upon invitation by Mexican authorities, veterinarians of the Department of Agriculture left immediately for the stricken area. On December 26, these men pronounced the epidemic foot-and-mouth disease, and the border was again closed to Mexican cattle. During the period between October 18 and December 27, 1946, approximately 151,800 cattle entered United States from Mexico.

PROBLEMS OF DISEASE CONTROL

Prior to November 26, 1947, chosen strategy was to destroy several centers of infection outside the main zone where the plague first started and then to attempt eradication of the disease in the main area. Suppression of infection in outlying sections reduces danger to non-infected Mexican lands, principally in northern Mexico, in the United States and in bordering Guatemala and other Central American countries.

Progress in disease eradication and control has been aided by United States personnel, equipment, supplies and money as well as by similar resources furnished by Mexico. As of December 1, 1947, 575 technicians from the United States were working for the Mexican–United States Commission for the Eradication of Foot-and-Mouth Disease. The Mexican section, on the same date,

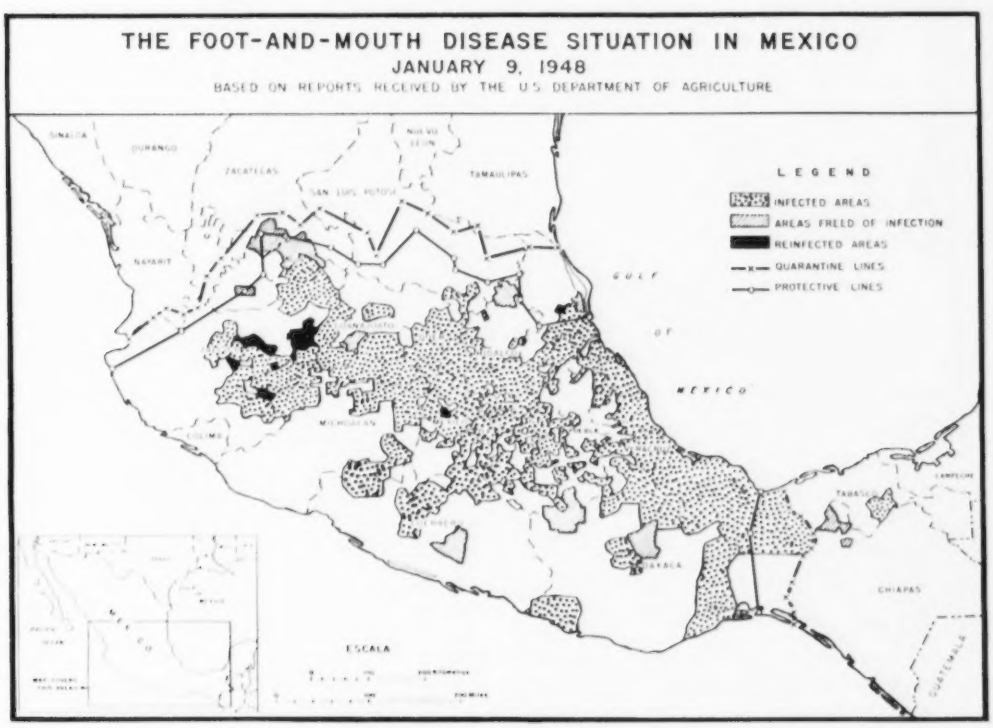

FIGURE 2.—Map showing control lines as of January 9, 1948. (Courtesy U. S. Dept. of Agriculture.)

included 331 technicians. At that time both sections jointly employed 1,079 mechanics, laborers, and clerks distributed among the infected or quarantined states and the commission's shop and warehouse in Mexico City. In addition, Mexican sources report that at one time about 15,000 Mexican troops were aiding in quarantine work and performing protective services.

FIGURE 3.—One of the cows in a Mexican dairy herd infected with foot-and-mouth disease. Salivation, caused by mouth ulcers, is one of the symptoms of the disease. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

Significant amounts of equipment and supplies have come from the United States Army surplus. On July 14, 1947 four units of the United States Army's traveling machine shops—the same type that maintained the mechanized armies of General Patton in the field—were made available for the campaign. Known as traveling garages by personnel of the United States Army and Forest Service, the units were extremely useful in Mexico where commercial garages and shops in rural areas are not ordinarily equipped to make repairs on the heavy vehicles borrowed from the Army for use in the war on disease.

In the period between May 14 and June 2, 1947, ninety freight cars of army surplus material were unloaded in Mexico City. Cargo included track-type gasoline powered shovels and bulldozers for use in rapid digging of burial pits; jeeps for quick transport of personnel and light supplies; high wheeled trucks for use over high crowned or rutted roads so widespread in Mexico; tank trucks and mobile spray units for carrying and applying disinfectants (Fig-

ure 6); a quarter of a million pounds of soda ash for disinfectant solution; and protective clothing such as rubber boots, gloves and other items.

Equipment, supplies and personnel involve expenditure of large sums of money. But larger still are the indemnity payments which have been made to owners (Figure 7) whose livestock is destroyed. On November 22, 1947, the number of infected or exposed cattle slaughtered in all infected states, since the beginning of eradication work, had reached a total of 504,560. The average indemnity payment was $49.92 (United States currency). The total number of swine, sheep and goats killed by November 22, 1947 amounted to

FIGURE 4.—At the beginning of the disease eradication program such ditches were dug by hand labor, a slow laborious process. Now the work is done by machinery, a much more efficient method. (Courtesy F. E. Mollin, Executive Secretary, National Livestock Association.)

358,158 costing an average of $5.08. From this it may be seen that costs have run into the millions of dollars.

As a part of a plan to maintain agriculture in stricken areas, the Mexican government, with the assistance of the United States, replaced many work

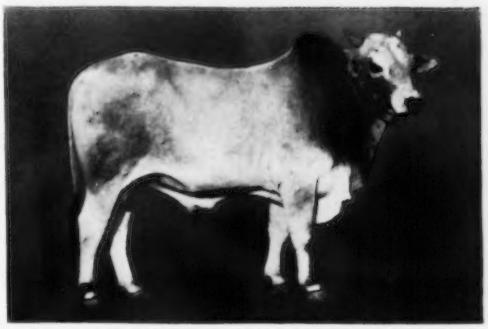

FIGURE 5.—Zebu cattle are more resistant to the high sun and diseases in tropical latitudes than animals belonging to many other breeds. (Courtesy U. S. Dept. of Agriculture.)

cattle destroyed in the eradication program with mules (Figure 8) and in some cases with tractors. Mules are not susceptible to foot-and-mouth disease, and they can be used on premises immediately following removal of diseased or susceptible livestock. Quantities of mule harness (Figure 9) and modern steel plows (Figure 10) to replace ancient wooden ones (Figure 11) were also distributed.

While prompt replacement of infected work cattle encouraged farmer coöperation, the exchange didn't satisfy many Mexicans. Mules have been used as draft animals for centuries, but the use of oxen has been much more widespread. Mules can't endure many conditions that oxen can, nor are peasants whose ancestors have walked behind slow moving oxen for hundreds of years likely to learn quickly and easily to manage and feed the more impatient animals. Of course, in the tropics, the mule is a

FIGURE 6.—Disinfection pits were made in roads for vehicles, and sawdust is saturated with disinfectant for pedestrians to walk through. (Courtesy Bureau of Animal Industry, U. S. Dept. of Agriculture.)

FIGURE 7.—Fred Thacker, United States appraiser, Rafael Lopes Ortiz, cattle owner, and Hector Lopez Arista, Mexican appraiser, discuss the indemnity for infected cattle on a farm near Salvatierra. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

better replacement than the horse; but the hybrid will not stand the high sun as well as the ox, he will resent goads more, and he may suffer more from the scanty and unfamiliar rations.

In many cases substitution of tractors for oxen proved unsatisfactory unless machines were introduced as community enterprises. Costs are high on an individual farmer basis; in isolated regions repairs are difficult to obtain, and farmers are slow to develop facility in installing them. For these and other reasons some farmers have hidden infected or exposed oxen rather than have them replaced by mules and machines.

Even worse drawbacks to the control campaign appeared. On September 1, 1947, a Mexican veterinarian on the staff of the joint commission, together with six soldiers, was killed by a mob in the state of Michoacan. Because of this happening, because of a lack of full coöperation and understanding by Mexican farmers, because of the lax quarantine enforcement by Mexican troops, and finally because Mexican government officials advised the commission that Mexico could not stand the economic shock of the destruction of possibly 5,000,000 cattle and a like number of hogs, sheep and goats, nor the disruptions brought about by quarantine procedure, the aim for prompt complete eradication of foot-and-mouth disease has been changed to one of disease control within present limits of infection.

The new course of action also includes United States assistance in setting up and operating, in Mexico, facilities for the manufacture of vaccines and vaccinating animals within the quarantine area to slow down the spread of infection.

The United States Department of Agriculture has long looked with disfavor upon the use of foot-and-mouth disease vaccines. Officials give several reasons for this attitude. Important among such reasons are the following: (1) vaccine is costly, immunity through the use of available vaccines lasts only from five to eight months, and to maintain protection, re-vaccination is necessary; (2) three recognized strains of foot-and-mouth disease virus have been identified and vaccination protects only against the type from which the vaccine is derived; animals would still be susceptible to other types; (3) some vaccinated animals are never fully resistant to the infection; (4) in the maintenance of vaccines' potency prompt application is necessary; in many areas of Mexico, transport and other conditions are such as to make prompt application impossible; (5) the procurement of wholly susceptible animals needed for producing and testing the product is difficult. Resort to vaccination, even in Mexico, marks a complete departure in United States Department of Agriculture's fight against foot-and-mouth disease. Control conditions must be extremely difficult or vaccination would never have been accepted.

FIGURE 8.—Jose Guadelupe Trajo, a Mexican farmer (left), turns in his purchase order to Major Jose M. Clave of the Mexican Army and gets mules to replace his slaughtered oxen. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

Finally the United States Department of Agriculture plans to continue the program of purchasing millions of pounds of canned meat in northern Mexico for shipment abroad. At present no purchase for use within the United States is contemplated; for although the heating coincident with canning meat kills the foot-and-mouth disease virus, Mexican meat, even if canned, is not accepted for consumption in the United States. This is because the United States has not yet recognized Mexico's meat inspection. Purchase for foreign consignment seems wise because cattle raisers in northern Mexico, so close to the United States border, having a market for their beef will not only give active support to quarantine enforcement, but also will thin out cattle herds at proper intervals and thus greatly reduce the spread of infection. To facilitate the program, the United States Department of Agriculture is encouraging the erection of packing plants in northern Mexico.

SAFEGUARDS FOR THE UNITED STATES LIVESTOCK INDUSTRY

Many questions arise concerning the best means to protect United States livestock from the scourge affecting Mexico. If foot-and-mouth disease is not eliminated, or if it remains active in Mexico for several years, the United States will maintain strict quarantine against the normal yearly import of 500,000 cattle. Control may be made easier by building a fence along the southern boundary of the United States. For many years prior to the outbreak of the present epidemic, stockmen have wanted such a fence to discourage cattle infection north of the border by the cattle tick, *Boophilus annulatus*, carrier of Texas Fever. The present outbreak of foot-and-mouth disease has enlivened agitation and has encouraged introduction of legislation for a fence building program. The border follows the Rio Grande for 1,210 miles, the Colorado for 20 miles and overland territory from El Paso to the Pacific for 675 miles, a total of 1,905 miles. On a small part of the Texas-Mexican boundary, abrupt escarpments (Figure 12) along the Rio Grande make a fence unnecessary. The fence should make patrol easier and less expensive and should prevent livestock of all kinds from moving across the line of their own accord; it would also greatly aid the control of livestock smuggling.

F. E. Mollin, Executive Secretary, American National Livestock Association writes that the main opposition to a fence comes from farmers in the Lower Rio Grande Valley who fear it will prevent Mexican labor crossing the border in violation of immigration laws. Valley land owners say that they cannot harvest crops without such labor. If immigration authorities cannot stop illegal entry, it seems doubtful a fence would slow up the movement.

Question has arisen about spread of sickness through seasonal flights of birds from Mexico to the United States. M. R. Clarkson, writes that practical experience in fighting foot-and-mouth disease in the United States, England and Continental Europe shows that migratory birds are of little importance.

Both wild and stolen animals moving between infected and non-infected areas normally offer a problem to infection control. Experts attached to the commission have reported that contrary to earlier expectations, wild animals have not been a serious challenge. Peccaries and small deer are found in Mexico, but in recent years, hunters have driven most deer north of the present infected region. Unless there is a serious drought authorities expect deer to stay on their present ranges. A drought would make

it necessary for deer to extend their foraging grounds in order to sustain life. Should infection prove more serious than now believed, a corps of experienced hunters may be recruited to free the area of susceptible wild life.

It seems pertinent to mention the manner in which the United States met the wild animal problem during the California outbreak of foot-and-mouth disease in 1924. In that year the infection spread to deer ranging through rough and inaccessible mountain terrain. Lack of attention to these animals might well have lessened the effectiveness of the eradication program. But

FIGURE 9.—Harness for mules that replace the slaughtered oxen is carried out from a supply station at Salvatierra. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

veterinary officials promptly put a ring of sharpshooters around the infected area and in the final count, deer comprised about 22,000 of the 132,000 animals destroyed in the ten-month long outbreak.

Since the outbreak of foot-and-mouth disease in Mexico and the consequent threat of infection spreading to the United States, the desirability and need for government research has been recognized by professional groups as well as by many segments of the livestock industry. These organizations recently recommended that a long-time research

FIGURE 10.—Four campesinos from Salvatierra pick out their steel plows at one of the supply stations. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

program be started and that it be conducted under United States jurisdiction on United States territory. (For full details see Supplement No. 11 to Summary of Developments in the Mexican Outbreak of Foot-and-Mouth Disease, United States Department of Agriculture, Agricultural Research Administration, Bureau of Animal Industry, January 29, 1948.)

Hearings have been held before the House Committee on Agriculture to consider the long-range research program covering such problems as: (1) fundamental research on the virus itself including its physical, chemical and biological properties and its relations to other viruses; (2) studies of modes of transmission including carrier animals, wildlife, etc.; (3) attempts at development of better diagnostic methods; (4) studies of the different strains of

FIGURE 11.—Small farmers, or campesinos, in many parts of Mexico still cultivate their land with oxen yoked to wooden plows. (Courtesy U. S. Dept. of Agriculture, Office of Information Press Service.)

the virus and their relations to one another; (5) attempts to develop more effective and less expensive vaccines; (6) efforts to develop more efficient methods of disinfecting contaminated premises and areas. The most immediate problem is a decision on the location of a station to conduct the long-range research plan.

Up to the present, whatever research on foot-and-mouth disease that has been carried on by the United States government has been undertaken in countries outside our border—countries where the disease is endemic or where it has been active for some time. Fear of infection on United States soil has heretofore been so great that no serious attempt for local research would be considered. Now with the disease already within 250 miles of our own borders there is a better argument for a well-financed active research program on the United States mainland. Besides the threat of infection from near-by Mexico, air travel has made it possible for people and goods to come to America from any continent within a short while; and since foot-and-mouth disease is one of the most easily transmitted of all infections which attack livestock, modern means of transport have minimized our historic protection of distance.

Some authorities have suggested a coastal island location for government foot-and-mouth disease research facilities. Such isolation could remove the fear of contact with susceptible wild and domestic animals from the continent and danger of contamination through human traffic. But an island also carries the handicap of a need for greater handling of materials necessary for research and provides a serious problem from the standpoint of a contented personnel.

Possibly a better location would be a mainland peninsula with a very narrow isthmus connecting the large distant part of the seaward extension with the continent. The narrow isthmus would lessen difficulty in protecting the continent from infection and also make access to the mainland much easier than from an island. Access to the sea coincident with a coastal location would make easier the procurement of diseased animals from foreign lands—animals that could be used for research purposes. Furthermore the sea would facilitate the safe disposal of disease-infected effluent and manure after suitable preliminary disinfectant treatment.

The Pirbright Foot-and-Mouth Disease Research Institute in Britain was built some distance from the coast without the protection of an island or peninsula location. Here, in the county of Surrey, about 30 miles from London, the United States on occasion has coöperated

FIGURE 12.—Fence building will be unnecessary along this section of the United States Mexican boundary. (Courtesy National Park Service, U. S. Dept. of Interior.)

with the British in seeking answers to foot-and-mouth disease problems. The immediate vicinity has but few cattle and other susceptible farm stock. About a half dozen small dairy herds graze within about a half-mile to a two-mile range of Pirbright, and a number of large dairies may be found within five or six miles. In spite of the nearness of these animals, owing to the stringent rules in force, there has never been any evidence that outbreaks of foot-and-mouth disease have been due to escape of infection from the institute.

According to some authorities, if the disease crosses our borders it will be more virulent than in Mexico. In South America, where the malady has long been endemic, livestock have developed a certain resistance that weakens the attack, and death loss is seldom over

FIGURE 13.—Year-round grazing is possible throughout the Argentine Pampa and on most lowland pastures of Latin America.

3 per cent of the affected animals. Minor losses may be influenced by the mild climates found over most of lowland South America, climates which permit cattle raisers to practice year-round grazing (Figure 13).

Many livestock men wonder what the United States Department of Agriculture will do if the disease spreads across the border. If control practices used in the nine outbreaks occurring between 1870 and 1929 are followed, the slaughter and burial method (Figure 14) for all exposed and infected animals will be continued. But should the disease become widespread and should a cheap successful vaccine be discovered, one assuring immunization of the susceptible

FIGURE 14.—Infected cattle have been driven into the pit for slaughter and burial. (Courtesy U. S. Dept. of Agriculture, Bureau of Animal Industry.)

animal for life, it is possible that a change of control may be tried. A few decades ago, hog cholera threatened the United States swine industry. With the discovery of the serum-virus (simultaneous method), insurance from major death loss was assured at a small expense. Another such discovery may ease control of foot-and-mouth disease.

Some dissatisfaction over present methods of disease eradication and control has been voiced by the Texas Cattle Association (*New York Herald Tribune*, 2/29/'48). A Texas plan of attack would "combine wholesale slaughter of animals in the infected area with use of vaccine in the uninfected zone of northern Mexico. To compensate Mexicans for the slaughter of contaminated animals, the plan calls for shipment of cattle from the United States." This plan may be the correct one to follow but it will be extremely difficult to execute. The billion dollars expense suggested for its completion might not be the chief difficulty. Better Mexican coöperation would be necessary—coöperation from the Mexican farmers to a higher degree than that given in present eradication and control methods. Moreover, the United States

public, already suffering from high meat prices might oppose the shipment of millions of cattle from the present limited supply. Other difficulties could be cited.

What the final outcome will be is hard to predict. By the time this study is in print, the disease may be completely under control; on the other hand, it may spread across the United States border at any time. In either eventuality, the Mexican foot-and-mouth disease problem provides an excellent illustration of the dynamic character of economic geography.

SUMMARY AND CONCLUSIONS

Foot-and-mouth disease, one of the most infectious and widespread diseases attacking cloven-footed animals, has dealt a serious economic blow to Mexico and offers a grave threat to the United States thirteen billion dollar livestock industry. Normal annual import of a half-million Mexican cattle has been discontinued pending eradication or control of the disease. This deprives Mexican cattlemen of an easy market and removes opportunity to augment the American meat supply.

Personnel, equipment and supplies have been sent to Mexico, and Congress has already appropriated millions to eradicate or control the disease. It is possible that present efforts may prove successful. In case control is unsuccessful, quarantine against Mexican cattle will continue, a border fence may be built and Mexican beef surplus will go to countries other than the United States. If the disease crosses the United States border and becomes well established, control costs may reach billions, a meat and milk shortage of serious proportions may result, and the slaughter and burial method may give way to the use of vaccines.

WHEAT PRODUCING AREAS IN PERU

Marjorie Smith Sommers

CONSIDERABLE attention has been devoted to the two main agricultural export crops of Peru—cutton and sugar—but little consideration has been given to subsistence crops. A principal subsistence crop is wheat. Although some wheat is imported, considerable quantities also are raised domestically. Wheat producing areas and amount of land under wheat cultivation, therefore, assume some significance in Peruvian economy.

Recent literature contains few maps dealing in detail with wheat producing areas in Peru. It is believed that a map showing distribution of wheat cultivation will be of value not only in showing chief wheat growing areas but also in indicating areas of subsistence agriculture. Thus, the type of map desired is one which will show amount of land under wheat cultivation and will delimit actual areas of cultivation. This paper presents methods used and problems encountered in constructing such a map.

The Map and Its Construction

The base map used was the one to five millionth Civil Division Base Map of the Americas, published by the American Geographical Society in 1944. The map has departmental and provincial boundaries. The Peruvian section was reproduced from the sheet of the northern half of South America at a scale three times larger than the original map.

Source of data used in compiling the map was the Peruvian government official census statistics for 1940. The *Extracto Estadistico Del Peru*, published in 1943 in Lima, contains a section on agriculture which gives varied information on a number of crops. Data are provided for amount of land under cultivation, production and yields. The statistics are the most complete and recent figures available.

Wheat statistics for Peru are given in hectares by departments and provinces. Province statistics were used because provinces comprise the smallest political unit for which figures are available, thereby giving the most detailed information possible. Number of hectares of wheat grown in each province was converted into acres to provide a standard unit of measure familiar in the United States.

As the number of acres of wheat grown in some provinces amounts to thousands of acres, it was not possible to have one dot represent one acre on the scale of the base map used. Hence it was necessary to establish a smaller unit of representation. The unit desired was one which would be large enough to simplify the map, but small enough to give as good picture of the distribution pattern as possible. Thus, the preferable unit would enable heaviest producing areas to be clearly defined, yet maintain representation of smaller producing areas which might be lost if too large a unit were employed. Various numbers of units were experimented with on selected large, medium and small sized provinces in order to determine the most satisfactory unit. Also, size of the dot in conjunction with unit was considered as the base map was to be reduced three and one-half times. The

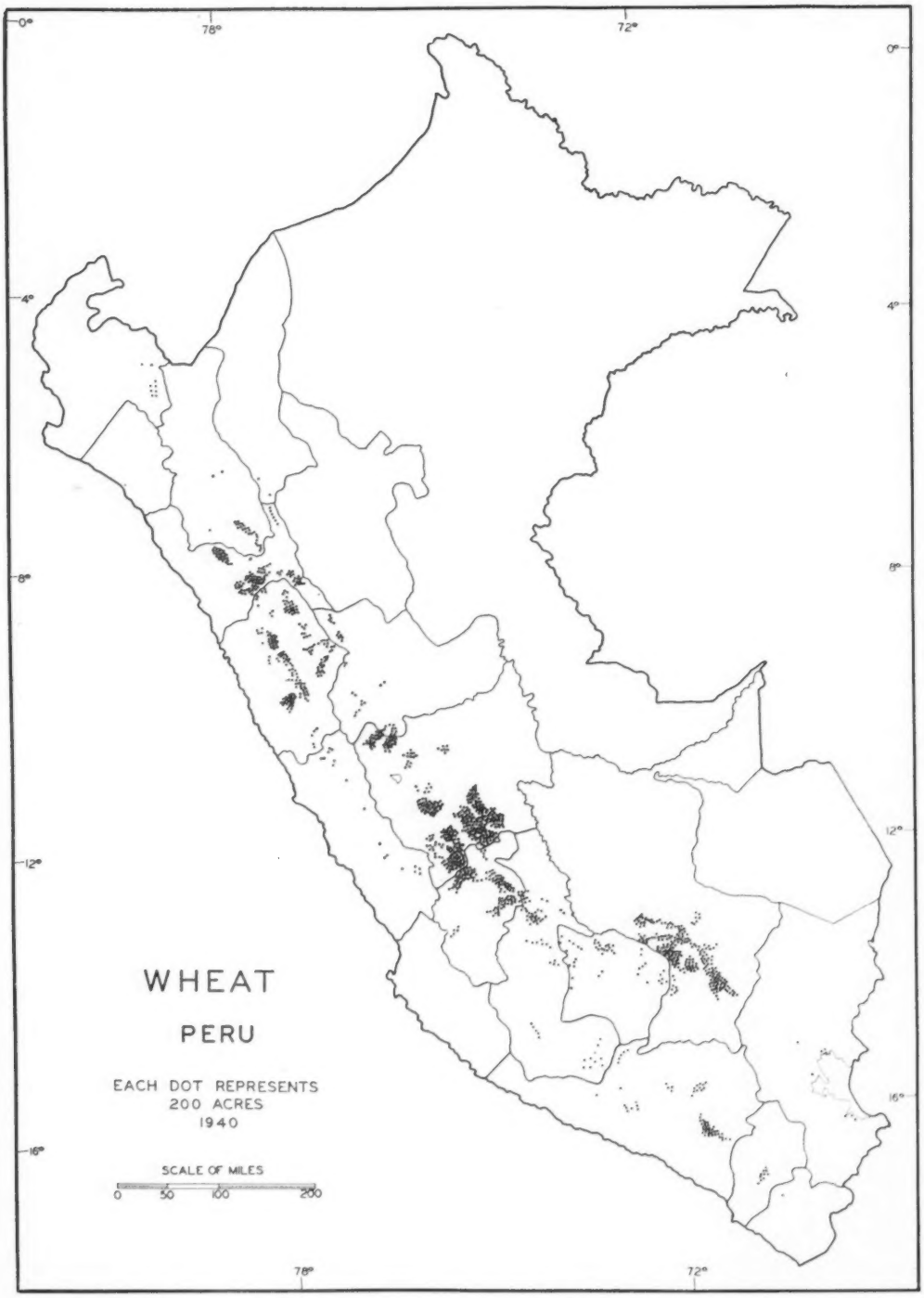

FIGURE 1.—Extent and distribution of wheat production in Peru, and the chief areas growing wheat. Data used in compiling the map are from the Peruvian government official census statistics for 1940. In Peru wheat is grown almost entirely in temperate highland regions between elevations of 7,000 and 13,000 feet, but does not ripen well at the higher altitudes of cultivation.

unit finally selected, one dot represents 200 acres used with a number four Wrico pen, fulfils the above requirements satisfactorily.

To present graphic representation of the wheat producing areas it was necessary to determine where, within each province, conditions were favorable for growth of wheat. Extensive research failed to disclose literature citing chief wheat cultivation areas within each province. Information was gained, however, on favorable conditions for wheat growth in Peru.

Wheat in Peru is grown almost entirely in temperate highland regions between elevations of 7,000 and 13,000 feet, but it does not ripen well at higher limits of cultivation. Temperatures and humidity which seem to be most favorable are found at elevations between 8,000 and 11,000 feet. Within this zone wheat is grown on intermontane basins, valley floors, and slopes in places as steep as 45 degrees. Also, within the zone and such types of terrain, precipitation further restricts area that may be devoted to wheat culture. Annual precipitation, which varies between 10 and 30 inches for the zone as a whole, changes greatly with elevation and exposure to rain-bearing winds. East of the western cordillera and in places east of the central cordillera, a deep northward or northeastward facing valley receives the heaviest precipitation on the westward flank. Detailed maps showing location of rural, village, town and city settlements, and also roads and trails emphasize the relationship. Since wheat in the area is primarily a subsistence crop, it is only natural that it would be cultivated in districts where the highland population lives.

After establishing the preceding conditions under which wheat would most likely be grown in the highland area of Peru, study was made of relief and settlement pattern of each department and province with the aid especially of the millionth map of the American Geographical Society. On a work copy of the base map, areas in which wheat would most likely be grown in each department and province were outlined, thus eliminating all areas of high altitudes where wheat could not be grown, very steep valley sides and very dry valley sides, and low latitudes where combination of high temperatures and high humidity would eliminate growth of wheat because of damage by rust and other diseases. Then, more careful study was made of the settlement pattern within the area where wheat would most likely be grown, and dots distributed in pencil on the basis of the entire preceding analysis. After location of the dots in pencil, the map was checked and then inked in. It is believed that the method has made it possible to give as complete picture of distribution of the wheat acreage in highland Peru as is possible without actual field investigation.

DISTRIBUTION OF THE WHEAT ACREAGE

The map shows striking concentration of wheat in the Sierra or Highlands where two-thirds of the Peruvian population are located. This highland subsistence crop is conspicuously absent in the Pacific Coast region and the eastern valleys and lowlands. Within this north-south zone of highland concentration, however, producing areas are extremely patchy and irregular. With exception of two heavy zones of concentration around the populated centers of Huancayo and Cuzco, areas of cultivation are small, localized, and distributed either in patches around settlements in intermontane basins or in distinct linear pattern along river valleys.

Areas of wheat cultivation differ in northern and southern Peru in amount

of land under cultivation and size of areas of concentration. The northern half of Peru contains 36 per cent of the 265,800 acres of land in wheat. No single area of wheat cultivation is prominent in the northern half of Peru, but acreage is concentrated in a number of small and scattered valleys. The extreme north is almost devoid of wheat cultivation. Beginning with Cajamarca valley (Department of Cajamarca) and Otuzco valley (Department of Libertad) in the north the zone of scattered cultivation extends south to the horseshoe concentration formed by the Rio Yanhuanca and Rio Huallaga valleys with the city of Ambo at the apex in the Department of Huanuco. Between these north-south extremes, most notable areas of concentration are the linear pattern along western valley slopes of the Rio Santa and clusters around the cities of Aija and Huari in the Department of Ancash and the city of Santiago de Chuco in the Department of Libertad.

The southern half of Peru contains 64 per cent of the Peruvian wheat acreage, of which large part is grown in two major areas. Approximately 33 per cent of the wheat under cultivation in Peru is centered in the Rio Mantaro basin in the Departments of Junin and Huancavelica with particularly heavy concentrations around the cities of Huancayo, Jauja and Ayacucho. Most wheat in the region is grown between elevations of 9,800 and 11,000 feet. An extension of the area extends northeast to the headwaters and tributary valleys of Rio San Fernando and Rio Tulmayo.

A second major zone of concentration is in the Department of del Cuzco; it contains 17 per cent of the total Peruvian wheat acreage. Acreage is concentrated in Rio Urubamba intermontane basin, centering around the city of Cuzco. Rio Vilcanota valley and the saddle between it and the Rio Apurimac valley show heavy production.

The Arequipa valley to the southwest is a minor area of concentration. In addition, there are other minor, widely scattered areas of wheat culture throughout favored linear valleys of the western cordilleras of southern Peru. Production in such valleys, however, is small.

URBAN SETTLEMENT IN HOKKAIDO

Alden Cutshall

SEVERAL years ago three articles on Japanese cities were published in American geographical journals. However, as a result of a more severe climate and because of more recent settlement and a less dense population, Hokkaido, both urban and rural, differs markedly in some respects from the islands of Old Japan. Hence, this paper will consider only urban settlement on Hokkaido, and in some instances point out similarities to, or contrasts with, cities of subtropical Japan.

Distribution of Population and Settlements

The population of Hokkaido (3,272,718) is densest in the western and southern parts of the island, but even there is sparse in comparison with central and southern Japan. Greatest population, both urban and rural, is on or near the Ishikari Plain, the most accessible lowland. Secondly, the major coal field of northern Japan along the eastern margin of the plain contributes to the greater density in this part of the island. And finally, the more severe winters on the eastern and northern plains have tended to retard settlement and development in those sections, even though they are quite capable of supporting a denser population.

There are ten *shi* and fifty-four *machi* on the island, of which four shi (Sapporo, Otaru, Yubari, and Iwamizawa) and twelve machi are within the Ishihari lowland or are sufficiently close to its borders to share in its economy. The other shi are widely scattered: Hakodate and Muroran on the southern peninsula nearer Old Japan; Kushiro on the southeast coast; Obihiro, the regional capital of the Tokachi Plain; and Asahikawa and Kitami, major settlements north of the forty-second parallel. The first colonists to settle in Hokkaido were fishermen and the oldest settlements are on the coast. Four *shi* and twenty-nine of the fifty-four *machi* are coastal settlements (Figure 1).

Urban Characteristics

The cities and major towns of the northern island, except Hakodate, Otaru, Nemuro, and possibly Kushiro represent comparatively recent settlement. They differ considerably from cities of southern Japan. Except where terrain conditions dictate otherwise, a rectangular grid pattern prevails. Streets are, in general, wider but most of them are unpaved. In Sapporo and Obihiro there are thoroughfares 100 or more feet in width with parkways, canals, or even small street stores in the center of the roadway. Crowded conditions so characteristic of Oriental street scenes are markedly lessened or entirely lacking. Residential areas are less compact; parks and other open spaces, more common than in most Japanese cities. Style of architecture, too, varies somewhat from that of the three southern islands. The use of wood, rather than brick and tile, is more prevalent. Construction appears more substantial, although the sturdier appearance is somewhat misleading; homes are not adequate in view of winter temperatures. The western influence so

often described as having influenced construction in Hokkaido is less noticeable in the urban landscape than in purely rural settings.

All cities and most larger towns have rail connections, and, with few exceptions, are served by one or more improved roads. Telegraph and telephone service (public, rather than domestic) and electricity are available in all cities and large towns. However, piped water and gas can be obtained only in the principal communities. Methods of sewage disposal are typically Oriental.

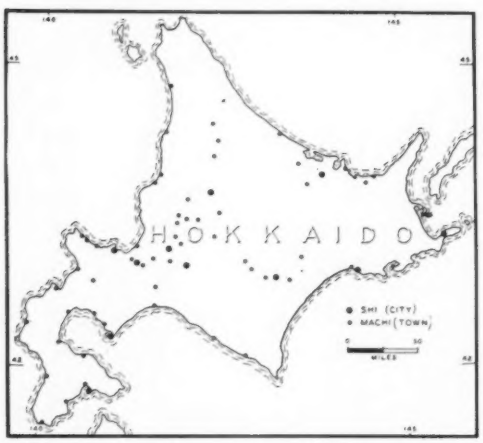

FIGURE 1.—Distribution of urban aggregations in Hokkaido; indicated by location of the ten *shi* and twelve *machi* within the Ishikari Lowland or close to its borders, and other *shi* and *machi* beyond the lowland.

THE LARGER CITIES

Sapporo (population: 222,827) is the capital and largest city. It is administrative center for the Hokkaido railway system and commands the junction of the lines serving the southern peninsula. It is the principal industrial center, with foods and textiles predominating, and a major assembly and distribution point for farms of the Ishikari Plain, coal mining communities thirty to forty miles to the east, a small oil field thirteen miles north-northeast, and sulphur mines fifteen miles southwest. In addition, it is seat of the Imperial University and site of a major airfield and wartime military training field. Industries include a large brewery, mills for processing rice, wheat, flax and hemp, and shops for construction and repair of railway equipment. A paper mill and a large steam electric plant are at Ebetsu, a few miles east of Sapporo.

The city is on the southwestern margin of the Ishikari Plain, eight miles from the coast and twenty miles southeast of Otaru, principal port on the island. A small stream, Toyohira-gawa, flows along the eastern side of the city and separates it from Toyohira-machi, a community of 17,268 people and integral part of the Sapporo urban area. Five highway bridges connect the two communities. A group of uncultivated rock hills bound the city on the west and southwest, but on both the north and south urban settlement grades into cultivated farms. Sapporo was laid out on the American plan in 1871 and is more westernized than most Japanese cities. Wide streets and avenues intersect at right angles to form a near-perfect rectangular pattern. Substantial modern buildings of three to five stories in the downtown area and the two-story concrete (or stone) university buildings on the northern margin of the urban area reflect western influence and recent development of the city. Purely Japanese architecture predominates in residential sections, however.

In contrast to Sapporo, *Hakodate* (203,862) one of the older, congested cities, was formerly the major port, although now surpassed by Otaru. It is one of the major fishing centers in the Far East and is an assembly and distribution point for marine products and equipment not only from Hokkaido but also for those from Karafuto, the Kuriles, and Siberian waters. The city occupies a strategic position commanding the Tsugaru-kaikyo (strait) between

Hokkaido and Honshu. Hakodate is southern terminus of Hokkaido's rail net and site of train ferries to Aomori on northern Honshu. It is a financial center, probably dating from an earlier period when it was the principal settlement on the island. Manufacturing is principally associated with the fishing industry, namely shipbuilding and the processing of sea products. The city has no significant local hinterland, but its position near Honshu and at the southern terminus of the Hokkaido railway system has made it a major port for domestic trade. Foreign commerce, mainly marine products, is unimportant by comparison.

The urban site extends for three miles along the inner side of a curved peninsula which forms the eastern shore of Hakodate-wan (bay). The peninsula is really a sandy spit connecting the mainland with Hakodate-yama, a 1,000-foot mountain. The original settlement was on the lower northern slopes of the mountain, and expansion has been northward to cover the flatter isthmus. The principal streets extend the length of the city and parallel the harbor front. Short, narrow, and oftentimes unpaved streets lead up the slopes from the bay. Congestion in Hakodate is a marked contrast to the wider streets and larger open areas of Sapporo and other newer cities. A major fire destroyed much of the central part of the city in 1934 and since that date only fire-resistant (possibly not fireproof) buildings have been constructed in the rebuilt area.

Otaru (population: 164,282) is the principal port and primarily a commercial city that serves the Ishikari plain and adjacent uplands and basins. In some respects it has also been the distribution point for Karafuto and the Chushima group (Kuriles). Its exports of coal, lumber, fish and agricultural products are counterbalanced by imports of machinery and miscellaneous manufactured goods.

Otaru is a compact and congested city on the southernmost indentation of Ishikari-wan, twenty miles from Sapporo. The urban area consists of the coastal strip paralleling the shore of the bay and extends fingerlike into the surrounding hills along three small streams that flow through the city and empty into the bay. Railroads, warehouses, and storage yards for coal and lumber line the shoreline, with principal residential areas on the steep slopes behind the business district. Streets are narrow, but generally paved. The bay is large but shallow, not more than 25 feet within the breakwater, so cargoes must be handled largely by lighters. A 300-foot modern coal pier occupies a favored location and some of the larger coastal vessels used in the coal trade come alongside and load cargoes, principally for parts on Honshu.

Muroran (population 107,628) is the third port and fourth largest city on the island. It is the second largest iron and steel center in Japan and was a center for manufacture of heavy military equipment and naval ordinance. It has been a coaling station for ships using the North Pacific, and coal (from the Ishihari Field) has been one of the major exports. Its rank as a fishing port is significant, but that phase of the economy has been obscured by the huge iron and steel works. Ores, metals, and coking coal for iron and steel plants are the principal imports; coal and sulphur the only significant foreign exports.

Muroran occupies a strategic position on the inner side of a curved peninsula at the northern side of the entrance to huge Uchiura-wan (Volcanic Bay). The peninsula, a spit and its land-tied island, partially encloses, and hence protects a deep, natural harbor. Lowlands on the

inner protected side are occupied by the heavy industries and the commercial district, thereby forcing fishing activities to the Pacific side of the peninsula.

Since level land is limited, filling and draining operations have extended port facilities and related installations into what was a shallow, coastal portion of the bay. Steeply inclined streets, even stairways, lead from the small coastal strip to isolated residential sections in the hills of the original island. Rapid residential expansion during, and immediately preceding, the war years was largely temporary in nature, much of it barrack-like apartments and dormitories for industrial workers.

THE LARGEST TRULY INTERIOR SETTLEMENT

Asahikawa (population 87,514) is the largest city north and east of Sapporo and the second largest interior city. It is an excellent illustration of a community with a diversified economy. Commercial activity probably predominates, as it is a focus for railways and highways which converge from all points of the compass. Hence, it has become the major assembly and distribution point for the agricultural basins and valleys of north-central Hokkaido. Furthermore railroad yards in the south part of the city are the only repair shops for rolling stock in the northern two-thirds of the island. There are several industries, principally rice mills and saw mills, but most of them are not large employers of labor, and further reflect the agricultural and forest resources of the tributary territory. Finally, the governmental function is significant, as Asahikawa was the divisional military headquarters for Hokkaido and Karafuto, and site of a permanent military reservation, which was especially noted for training ski troops and related wintertime maneuvers.

Asahikawa lies seventy-five miles northeast of Sapporo in the high, level, alluvial Asahikawa basin, formed by three rivers which converge at the city. Well-drained alluvium of the basin floor permits high percentage of the area to be devoted to paddy rice and thereby supports denser population than most of northern Hokkaido. The city proper lies between the Chubetsu-gawa and Ushishubetsu-gawa, just upstream from their confluence with the Ishikari-gawa at the western edge of the city. Two smaller settlements, Tokiwadori and Ichigo, lie north of the city and are separated from it and from each other by rivers spanned by major bridges. Streets are wide but most of them are unpaved. They form independent rectangular patterns as dictated by the streams and railroads along the margins of the built-up areas.

THE YUBARI MINING CENTER

Yubari (population: 64,517) is strictly a mining community and the largest urban unit within the Ishikari coal field. The urban site along a small river, the Shihorokabetsu-gawa, is comparable to that of some of the mining cities of eastern Ohio and West Virginia, with railways, highways, and related installations on the narrow flood plain and frame residences extending up steep bordering slopes on either side. In reality political Yubari is tri-nucular: the main section near the head of the valley; Shin-yubari (New Yubari) a southward expansion of the older town; and O-yubari (East Yubari) a detached settlement around another mine six miles southeast.

LOCAL REGIONAL CENTERS

Kushiro (population: 63,180) is the largest city and principal port of southeastern Hokkaido. It serves neighboring

fishing settlements, a small nearby coal field, and to a lesser extent agricultural communities on the Tokachi Plain. Marine products, agricultural produce, coal, and forest products are shipped through its port, which ranks third in volume of exports. Piles of logs and lumber around the two or three saw mills near the harbor attest the extractive economy that predominates in southeast Hokkaido.

The city straddles the Kushiro-gawa, and occupies the small alluvial plain near the mouth of the river and part of the adjacent, low, flat-topped upland. A spacious harbor, protected by long breakwaters, lies in front of the city, but it is shallow and most of the freight is handled in lighters. To minimize silting, floodwaters of the Kushiro-gawa and its principal tributary are diverted through an artificial channel to empty outside the harbor. An attenuated residential development lines the highway to the Pacific coal mines two miles east of the city.

Obihiro (population: 36,555) and *Kitami* (population: 32,849) are regional capitals and agricultural market centers for the Tokachi and Abashiri (northeastern) lowlands respectively. Before incorporation in 1944 Kitami-shi was Nokkeushi-machi. This is one of the few cases in which a change of nomenclature accompanied a change in political status. It is assumed that the political area was unaltered and the population figure used is the 1940 population of Nokkeushi-machi. The same procedure was followed with respect to the population figures for Yubari and Iwamizawa incorporated in 1943 and 1944 respectively. *Iwamizawa* (population: 33,519) occupies a somewhat analagous position near the center of the Ishihari lowland, but its regional functions are overshadowed by those of Sapporo, twenty-five miles to the southwest. Kitami and Iwamizawa are railway junction points that were given *shi* status in 1944. The town of Ikeda, thirteen miles east of Obihiro is principal rail junction on the Tokachi Plain. Of the three regional centers, Obihiro serves the largest area and is the more significant distribution center. All three have some manufacturing, primarily industries processing raw materials from nearby farms and forests. Manufacturing in Iwamizawa is in part result of its proximity to nearby coal mines.

MACHI (TOWNS)

Collectively the machi (towns) represent a variety of functions, but in most cases a single reason accounts for the importance of each. Ebetsu, Tomakomai, and Tottori (a suburb of Kushiro) are sites of the three largest paper and pulp mills. Chitose serves major hydroelectric developments in the southern uplands. Takikawa, Fukagawa, and Ikeda are representative of towns at the junction of rail lines. Iwanai has the largest and best harbor between Hakodate and Otaru, and Rumoi is a coal and lumber port sixty miles north of Otaru. Abashiri, Akkeshi, Mombetsu, and others are primarily fishing communities and secondary ports, each with small hinterland. Nayoro, Shibetsu, Sunagawa, and Pombetsu form several communities that are principally agricultural market and service towns. Bibai and Utashinai are illustrative of the coal mining communities at the edge of the Ishikari Plain. In fact, only Wakkanai and Nemuro have more than local importance. The latter has the best harbor on the east coast and is Hokkaido's fifth port. Economically, it is a fishing community with canneries, and tangle factories. Aquatic products form the principal exports. Strategically and politically it has been a communication hub and administrative

center for the eastern tip of Hokkaido and the Kuriles. Wakkanai's importance is primarily strategic as it guards the northern entrance to the Sea of Japan and is site of the southern terminus of the railroad car ferry across Soya-kaikyo (strait) to Karafuto. Wakkanai is not included among the 54 *machi*. It had a 1940 population of 22,589 and is the largest settlement north and west of a line connecting Otaru, Asahikawa and Abashiri, but even so it does not have *machi* status.

Settlement patterns of the towns are inconsistent. The many fishing communities have, in general, a nondescript, unkept appearance. Where coastal terrain permits, compact settlement with well-defined street pattern is common; but if level land is restricted, the community may consist of crudely constructed isolated huts, or it may represent a modified-*strassendorf* settlement and extend a considerable distance along the shore or along a single street paralleling the shore. Some larger coastal settlements are at the mouths of small streams. Such a river-mouth location permits development of a fishing-lumbering-agricultural settlement, as logs are floated down the small stream and some agriculture is possible on the small deltaic deposit at the mouth of the river. Inland market towns and industrial communities are compact settlements with rectangular street pattern, in most cases. Secondary ports and rail junctions also are compact, but may be less rectangular in appearance if the coasts or rail lines form sharp angles or otherwise prevent or restrict normal development of the new or expanded community. Mining settlements may be regular or irregular in appearance; oftentimes they are attenuated in form. In a few cases a coal field *machi* consists of several small hamlets and separated homesteads each around or near a mine. Collectively the several small settlements and isolated dwellings form the *machi* administrative unit. For example, the largest settlement cluster in Bibai (population: 54,122) is only four or five blocks long and about as wide.

POPULATION OF THE MANOR COUNTIES OF MARYLAND

Henry J. Warman

"WE also, by these Presents, do give and grant license to the same Baron of Baltimore and to his heirs, to erect any parcels of land within the Province aforesaid into mannors, and in every of those mannors to have and hold a Court Baron . . . and view of Frank Pledge, for the conservation of the peace and better government of those parts." From Charter of Maryland, Art. 19.

"And We do . . . authorize you that every two thousand acres . . . so to be passed . . . be erected and created into a mannor. . . . And we do hereby further authorize you that you cause to be granted unto every of the said Adventurers within every of their said mannors respectively, . . . a Court Barron and Court Leet, to be from time to time held." Instructions from Lord Baltimore to Governor Calvert, 1636.

From the foregoing statements it is quite evident that the manor method of land parcelling and holding had its inception long before settlement took place in the New World.

One of the first scholarly works on the manor considers it to be a Roman institution appropriated by the Anglo-Saxons and adapted to their system of land tenure. The work of Frederick Seebohm, The English Village Community, printed in London, 1883, devotes much of the opening chapters to the description of the manorial system. Needless to say, explanations of the origin and growth of manorial systems are varied and diverse.

Origin of the Manor

The "Old Theory" of the origin of the manor was that of "a village community," a voluntary association, a simple unit, within which were households or families of various degrees of wealth, rank and authority, all equal in manorial status and influence; slowly the power of the lord grew, due to royal grants of jurisdiction, to the dangers which forced freemen to commend themselves to the leadership of some powerful neighbor, and to the assimilation of the free community under a lord's jurisdiction to a dependent community living on the lord's land.

Exponents of the "New View" of the origin of the manor introduce different ideas. A closer bond of kinship and the element of chieftainship enters the picture. They say that the Germans found the manorial system in England, in the Roman villa, and that they continued the system with chiefs as lords of the villas, which were worked by Teutonic and Celtic serfs and slaves.

Careful investigations of the past few years have not favored either of the two mentioned "views." Each theory seems to err in seeking to be too exclusive of the other. Charles M. Andrews in his work, *The Old English Manor*, says "Too many influences were at work to make any single system applicable." (A detailed account of the lands and tenants of the manor; agricultural arrangements, recreation, etc. In his introduction of 80 pages he gives his theory of the origin of the manor, while criticizing other theories. He takes a

middle ground.) The manorial system did not owe its origin solely to Celt, German, or Roman, each of which contributed elements to its development. Real origin of the manor must be sought in the peculiar environment which attended settlement and development of the Anglo-Saxons in England. Powerful forces were then at work which tended to subjugate the mass of the peasants to the lordship of a few nobles. But it finally required the Norman Conquest to complete that process—to systematize, extend, unify, and complete the manor.

Paul Vinogradov, in his two books, *Villainage in England*, Oxford 1892, and *The Growth of the Manor*, Oxford 1905, states his belief that communal ownership preceded individual tenure; that the freemen were degraded by military and economic forces, and by the Normans.

William I in 1086 sent out commissioners to collect data necessary to formulate a more remunerative system of taxation. At that time England seems to have been divided up into numerous manors, in various degrees of development.

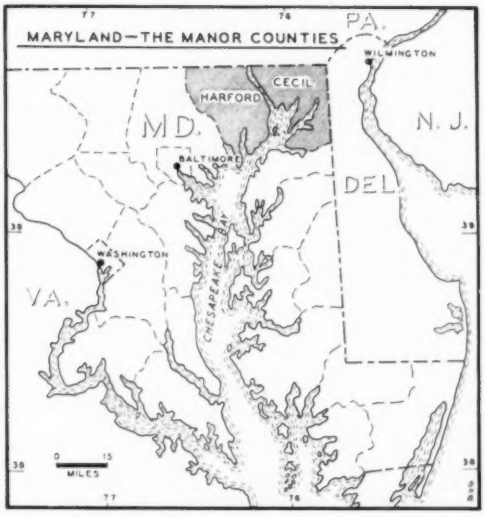

FIGURE 1.—The head of Chesapeake Bay. The highway of the sea and attractiveness of the land combined to encourage people to settle in the new land.

A TYPICAL MANOR

"A typical manor was composed of two elements; a manor house which was the seat of the lord of the manor, and a village of semiservile peasants. The land was divided into demesne, or lord's land, and village land. The arable land was divided into three great fields, two of which would be under cultivation each year while the third was allowed to lie fallow. Each of the fields was divided into strips about an acre each, separated by green balks. The strips were generally long and narrow—a shape more suitable for plowing. There were also gored strips, triangles, and the like, to conform to the terrain. A section of the strips lying side by side formed a shot, or furlong, each of which was separated by a broader balk, often overgrown with bushes. Meadows, pasture, and woods were generally undivided and were used in 'common.'

"Each tenant could pasture a certain number of cattle, sheep and swine on the 'common' land—and not even the lord of the manor himself was allowed to exceed that number.

"The chief bond of unity was probably agricultural."

Whatever the specific or varied forces that contributed to the manorial system may be, it is doubtless true that the system formed a definite stage in the economic development of society, and like all other stages, was largely the product of the environment and culture of the age.

To include in this article all areas where the manorial system was introduced would be too monumental a task. However, by confining the study to Maryland in general, and focusing detailed applications on Cecil and Harford Counties (Figure 1) located at the

head of Chesapeake Bay, enough territory will be encompassed and enough data uncovered to bring out the basic principles and forces involved in the manorial system transplanted to America.

MANOR COUNTIES

Harford and Cecil are the chief manor counties of Maryland. The Susquehanna River forms the northeastern boundary of Harford County, Chesapeake Bay the southeastern, and Gunpowder River and Little Gunpowder Falls most of the western. The longest dimension is about thirty miles, and the greatest width from east to west is about eighteen miles. The county includes an area of 442 square miles, or 282,880 acres.

FIGURE 2.—Side view of Tudor Hall, showing the stately trees around the Manor House.

Cecil County lies in the extreme northeastern part of Maryland. Chesapeake Bay and Susquehanna River form its western boundary. The Kent County line is its southern boundary. It comprises an area of 355 square miles, or 227,200 acres.

In the territory covered by Cecil and Harford Counties (Figure 1), the influence of geographic factors becomes obvious. Shape of the coastline, the great Chesapeake waterway, lured the explorer on to more and more complete discovery of its many arms. The highway of the sea and attractiveness of the land combined to encourage people to settle in the new land. They came, many by the sea approach, many from regions eastward in what later became Delaware, and many more from that great William Penn colony to the north, Pennsylvania. To establish respective rights to the great hinterland of Chesapeake Bay Mason and Dixon were called upon to perform their survey.

Thus is delimited the region of the Manor Counties of Cecil and Harford, located at the headwaters of Chesapeake Bay, bounded to the south by natural water bodies, to the north and east by man-made lines, and separated from each other by the great Susquehanna River, yet more closely bound together because of its tributaries and its far-reaching economic advantages. Many people found happy homes in the gracious, accessible region. (Figures 2 and 3.)

POPULATION—GROWTH

According to estimates and surveys made prior to the first Federal Census in 1790 the population of Maryland at different dates was as follows:

1660 (estimate)	8,000
1676 (estimate)	16,000
1701 (estimate)	32,258
1712 (census)	46,073
1715 (estimate)	50,200
1719 (estimate)	61,000
1748 (estimate)	130,000
1755 (census)	153,564

FIGURE 3.—The Library in Bel Air, county seat of Harford County. An indication of the staidness of the folk.

1761 (estimate)	164,007
1775 (estimate)	200,000
1783 (estimate)	254,000

Cecil County was created in 1674, and Harford County in 1773. The number of settlers in the state of Maryland quadrupled in the last half of the seventeenth century.

James T. Adams, writing of the Colonial period in his *Album of American History* states that "Cecilius Calvert as far as possible personally interviewed the men and women who were to take passage on the "Ark" and the "Dove." In 1633 he issued a pamphlet advertising the advantages of Maryland in which he, intentionally, or unwittingly perhaps, gave indication of the way the land would be used when he stated "each plantation is an independent, social, and economic unit.

One thousand acres of land were offered to each adventurer transporting five men to the province, with manorial privileges, at a rental of twenty shillings sterling, or in commodities, and "such other services as shall be generally agreed upon for publiche uses and the common good." Similar terms were offered to leaders of smaller colonies.

Second stipulations issued by the Proprietor directed that two thousand acres could be granted, for five able-bodied men and the yearly rental of four hundred pounds of good wheat. Each adventurer was required to "inhabit and plant" the land taken up by him.

By referring to the graph on Population Growth, 1790-1940 (Figure 4), a clearer analysis may be made of this population table.

The graph of Population Growth (Figure 4) emphasizes the rather rapid increase in the total population of the Manor Counties between 1790 and 1880. Since 1880 there has been a leveling off of the curve, some decline,

TABLE I

POPULATION—GROWTH

Date	*Cecil County*	*Harford County*	*Total*
1790	13,625	14,976	28,601
1800	9,018	17,626	26,644
1810	13,066	21,258	34,324
1820	16,048	15,924	31,972
1830	15,432	16,319	31,751
1840	17,232	17,120	34,352
1850	18,939	19,356	38,295
1860	23,862	23,415	47,277
1870	25,874	22,605	48,479
1880	27,108	28,042	55,150
1890	25,851	28,993	54,844
1900	24,662	28,269	52,931
1910	23,759	27,965	51,724
1920	23,612	29,291	52,903
1930	25,827	31,603	57,430
1940	26,407	35,060	61,467

and if figures since 1940 could be shown, a decided upward trend would be revealed.

Although graphs for Harford and Cecil County show fluctuations, they fluctuate contemporaneously. Further analysis will reveal that each county was affected by the same general influences, even though there may be slight discrepancies in the fluctuations.

When the land was first settled in the manors it was along streams that colonists found that they could go almost everywhere by boat and they felt small need for making roads.

The drop in total population of the two counties from 1790 to 1800 is due largely to more accurate censuses taken as the project continued. However, the gradual increase in Harford County's population accords with development of better roads into the interior back from the broad river estuaries.

The peak of 1810 marks influx of people during the canal building era. The Susquehanna and Tidewater Canal and the Chesapeake and Delaware Canals had much to do with the population growth during the years 1810 to 1860, both because of the man power needed in their building, and the spur given to economic activity as consequence of their construction.

The static condition of population in Harford County during the years 1810 to 1850 is compensated for by increase in Cecil County.

The years 1827 to 1850 also were marked by the railroad era, when the Pennsylvania Railroad and the Baltimore and Ohio vied for control of satisfactory rights of way.

The years 1860 to 1870, the Civil War period, naturally show no marked increase. After the internal strife of our country had ended, population of both Cecil and Harford Counties increased and the peak marked maximum peopling until the present. An outstanding feature of statistics for the year 1920 is that even the great World War I had no depressing effects upon population.

Changes in 1910 and 1920 are closely connected with changes in specific occupations, and occupations that are classified with difficulty. A change in census date from spring, in 1910, to midwinter, in 1920, naturally reflected great changes, especially in seasonal occupations.

A general observation that may be made concerning growth of population in the Manor Counties is that ever-upward trend, in spite of small variations, is strongly evident, but gradual enough to indicate that the bases for growth are fundamentally sound and not of a "skyrocket" nature.

POPULATION—DISTRIBUTION

During early settlement of the counties, population was confined largely to the coastal-plain section (Figure 5), and to banks of larger streams (Figure 6). The first English settlement was made

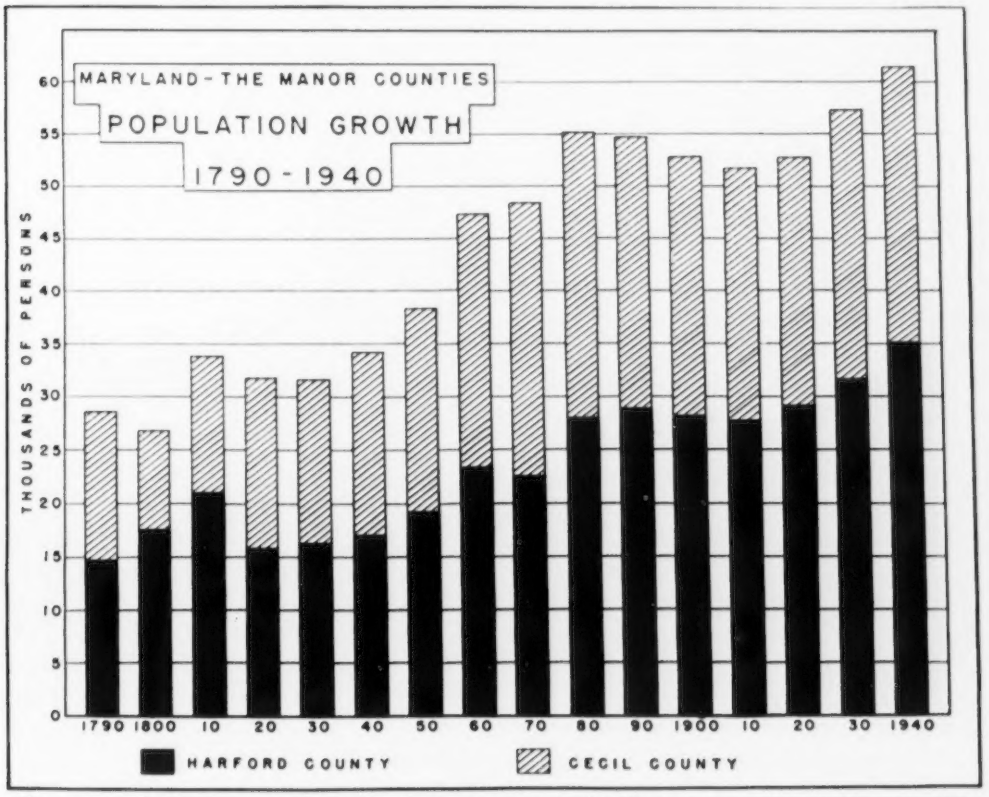

FIGURE 4.—Each county was affected by the same general influences, even though there are slight discrepancies in the fluctuation.

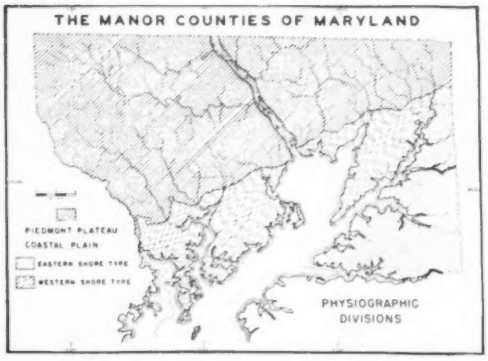

FIGURE 5.—Early population was confined to the coastal plain section and to the banks of the larger streams.

FIGURE 6.—The first settlements fronted on the broad estuarine rivers, the settlements on the Piedmont were interfluvial.

on an islet, now known as Garrett Island near the mouth of the Susquehanna River, and a trading post was established there before arrival of the Pilgrims of Maryland under Leonard Calvert in 1634. All the earliest inhabitants settled in the southern and southwestern parts along Chesapeake Bay, and Northeast, Elk and Sassafras Rivers.

In Maryland, as in Virginia, the tendency prevailed for the more opulent to secure large tracts of arable land along the waterways, which effectually restricted greatly the growth of towns, such as those which, during the same period, were so rapidly expanding in New England. In 1683, the Assembly passed "an Act for Advancement of Trade" which aimed to encourage creation of more towns, and sites were listed; but it is one thing to order the laying out of a town, and quite another to get it actually settled. Unless fundamental factors prescribe or direct the course of human lives, the course is destined to be thin, rambling, and eventually lost.

The maps (Figures 7, 8, 9, and 10), showing Distribution of Population reveal to marked degree the surprising stability of inhabitants per square mile within certain periods. From 1790 to 1850 the ratio is eighteen to forty-five inhabitants per square mile; from 1860 to 1930, forty-five to ninety inhabitants per square mile.

TABLE II

PERIODIC POPULATION OF THE MANOR COUNTIES

Harford County	*1800*	*1870*	*1900*	*1940*
Abingdon	2,715	2,598	2,702	5,782
Halls Cross Roads	4,825	3,805	5,631	6,828
Bel Air	5,282	5,650	6,349	7,800
Marshall	4,485	4,409	4,566	4,489
Dublin	4,145	3,862	5,598	5,194
Havre de Grace	1,163	2,281	3,423	4,967

Cecil County	*1860*	*1870*	*1900*	*1940*
Cecilton	3,254	3,337	2,662	2,182
Chesapeake	2,610	2,683	2,251	2,301
Elkton	3,852	4,170	4,917	5,890
Fair Hill	2,121	2,219	1,931	1,759
Northeast	3,501	3,645	3,511	3,693
Rising Sun	2,302	2,618	2,617	2,562
Port Deposit	3,506	4,198	4,298	6,058
Oakwood	1,203	1,440	1,214	889
Calvert	1,513	1,560	1,261	1,073

According to the Atlas of Historical Geography, early settlers encountered two major linguistic stocks of Indians, the Iroquoian and the Algonquian. The tribes, which contested sporadically with the settlers for the better territory, were Delawares, Nanticoke, Powhatan and Susquehanna.

In their first movement inland, the settlers were aided greatly by the

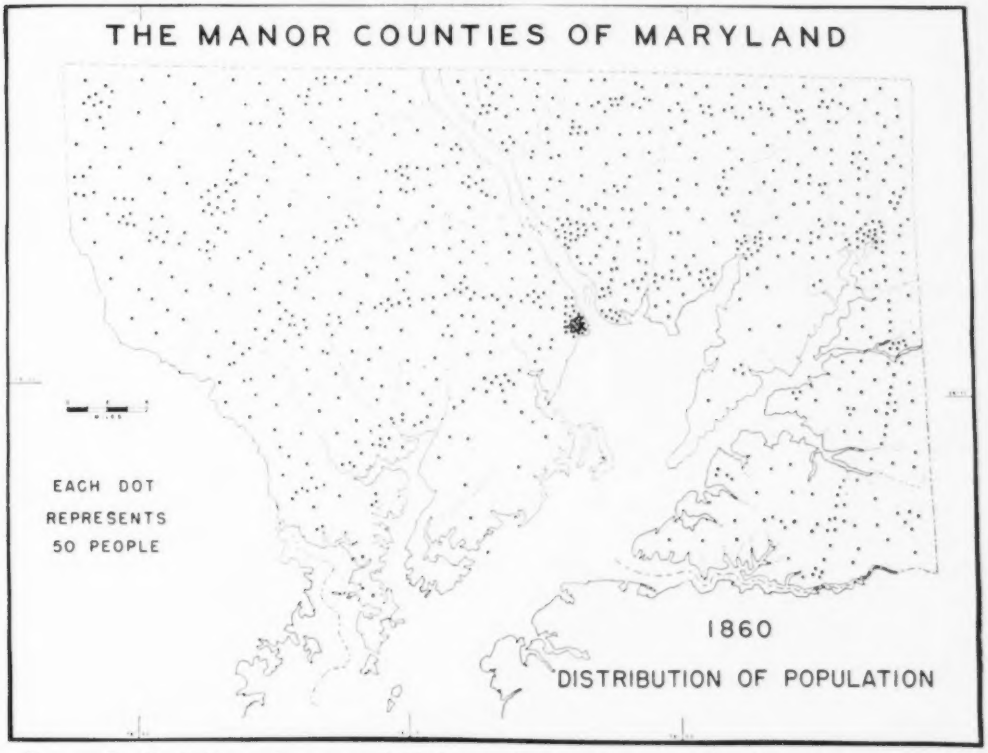

FIGURE 7.—In 1860 people were sprinkled sparsely over the area with what appears to be a deliberate avoidance of rivers and streams.

numerous branches of the Chesapeake's tributaries, but later the movement completely changed. Instead of clustering along waterways people began occupying interfluvial areas, as the maps clearly reveal (Figure 11). In 1860 (Figure 7) people were sprinkled sparsely over the area with what appears to be deliberate avoidance of rivers and streams. The map of 1870 (Figure 8) substantiates to greater degree this interfluvial pattern of population. By this time, however, growth of certain communities such as Elkton (Head of Elk), Chesapeake City and Port Deposit in Cecil County, and Havre de Grace and Bel Air in Harford County becomes conspicuous (Figure 12).

By 1900 not only the pattern of population became more indelibly imprinted, but routes of transportation attracted particular attention (Figures 13 and 14).

While doing field work in the area, the author attempted to ascertain the size of the war-swollen populations in the larger towns. Estimates by local authorities in Aberdeen were 10,000 for that area; wives, sweethearts, and parents of men stationed at the near-by Proving Grounds constituted a large part of the casual populace.

Cecil County	*1850*	*1860*	*1870*	*1900*	*1940*
Elkton	1,099	.....	1,797	2,542	3,518
Port Deposit	1,008	.....	1,839	1,575	.....
Chesapeake City	423	.....	1,008	1,172	.....

Harford County	*1850*	*1860*	*1870*	*1900*	*1940*
Havre de Grace	1,335	1,963	2,281	3,423	4,967
Bel Air	255	197	633	961	.....
	.....	.....	.....	600	.....

Additional munitions plants in and around Elkton caused increase there from 3,518 to 6,000 (estimated).

The modern population pattern (Figure 10) shows no variation of either concentrations of people or routes of transportation with their accompanying enterprises.

Were they economic or social? Were they geographic? If geographic, which played the major role, or did they all operate to mold the destiny of the folk who came to the Manor Counties? Perhaps none of them gives the complete answer. Does the solution lie in the composition of the population?

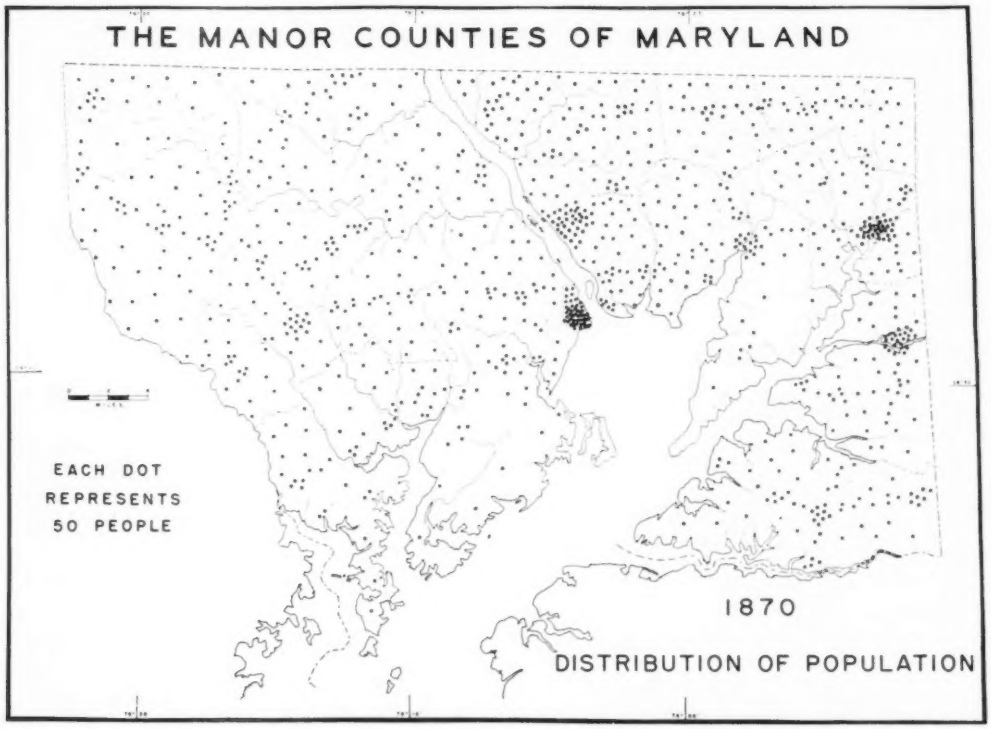

FIGURE 8.—The growth of Elkton (Head of Elk), Havre de Grace and Bel Air became conspicuous (see also Figure 11).

After careful analysis of the four population maps and the statistics table supporting them, certain generalizations can be made. The first is that whatever it was that encouraged early settlements along the coastlines it did not possess enough holding power to keep them there. The second is that when the movement became diverted inland, the driving and attracting forces caused people to occupy interfluvial areas and not the proximity of natural waterway sites.

Were the forces political or religious?

POPULATION—COMPOSITION

The earliest settlers in Cecil County were mainly English and some Dutch. In Harford County the earliest settlers likewise were largely from England, with later settlers coming in from Virginia and the Carolinas. Descendants of the English are now scattered all over the state, and comprise the leading element in the population. Many settlers in sections adjacent to Pennsylvania were of German extraction.

In the census of 1860 the foreign-born population statistics were not broken

down into counties but Maryland's population was 599,860 of which 77,529 were foreign born.

The number for the state was further broken down, as follows:

43,884 from Germany
24,872 from Ireland
4,235 from England
1,583 from Scotland
701 fromWales

and no other country sent over 600.

It is reasonable to assume that the proportion in the counties was about the same as in the state. In 1850, the foreign-born in Cecil County totaled 702; in Harford County 991. In 1860 there was increase in either county, 1,502 foreign-born in Harford County and 1,342 in Cecil County, the census totals at that time.

The following tables help interpret the charts of foreign-born population (Figures 15, 16, and 17).

The check-up in the year 1870 brought forth the fact of 2,266 foreign-born people in the Manor Counties, of whom 1,060 resided in Cecil County and 1,206 in Harford. The table shows their native lands.

To be overimpressed by the three tables on foreign-born population would be a decided mistake. The percentage of such population forms only 4.6 per cent of the total for the Manor Counties in 1870; 2.8 per cent of the total in 1900; and but 2.5 per cent of the total population of 61,467 in 1940. Nevertheless distribution of ancestral countries throws much light on trends of the times. Whereas Ireland and Germany dominated the immigrant picture in the years 1870 and 1890 (Figures 15 and 16) the shift to Central Europe is remarkable in 1940 (Figure 17).

There is one major generalization

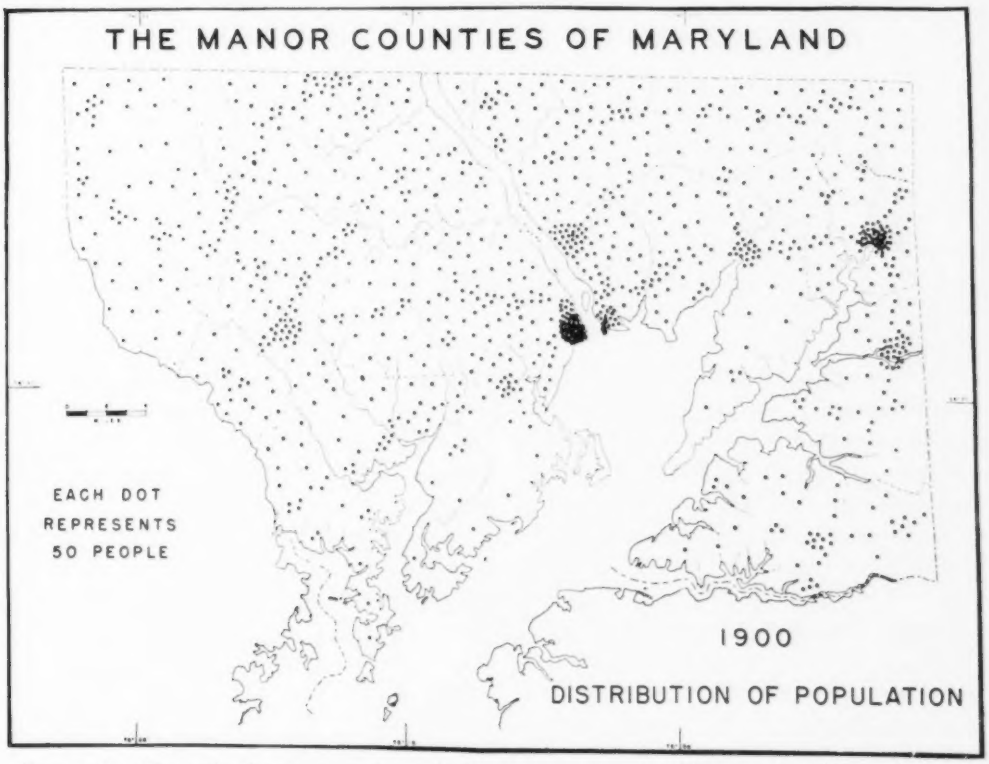

FIGURE 9.—Not only the pattern of population became more indelibly imprinted, but the routes of transportation attracted particular attention.

TABLE III

FOREIGN-BORN POPULATION—1870

Countries	*Cecil County*	*Harford County*
British America	16	12
England and Wales	201	108
Ireland	598	569
Scotland	18	28
Germany	193	403
France	23	14
Sweden and Norway	..	3
Switzerland	7	29
Austria	..	2
Holland	..	14
Others	4	24
Total	1,060	1,206

TABLE IV

FOREIGN-BORN POPULATION—1900

Native Countries		*The Manor Counties*
British Isles		725
Ireland	470	
England	141	
Wales	85	
Scotland	29	
Germany		476
Italy		142
Czechoslovakia		36
Russia		27
Canada		24
All others		75
Total		1,507

TABLE V

FOREIGN-BORN POPULATION—1940

Native Countries		*The Manor Counties*
Central Europe		767
Czechoslovakia	269	
Austria	178	
Germany	161	
Poland	113	
France	25	
Switzerland	11	
Hungary	10	
Northern Europe		309
England	95	
Irish Free State	72	
Scotland	41	
Finland	38	
Sweden	25	
Denmark	12	
No. Ireland	10	
Norway	9	
Wales	7	
Southern Europe		309
Italy	238	
Greece	52	
Yugoslavia	11	
Rumania	3	
Bulgaria	2	
Spain	2	
Portugal	1	
Eastern Europe		81
Russia	64	
Lithuania	17	
Canada		85
Near East		13
Low Countries		6
All Others		22
Total		1,592

that can be made concerning composition of the population from the very first census. The original settlers were tenacious in their holding of the land; their descendants have likewise been reluctant to give any of it up. The fiber and feelings of the men and women on the Manor lands even today bear testimony to the planning and effort put forth in claiming it, and the love for it which the early settlers had instilled within them during their pioneer struggles. One more fact we may only hint at for the present. Has the manner in which the land been used been responsible for the integrity of the population and the small percentage of immigrant foreigners?

POPULATION—EARLY OCCUPATIONS

Before white settlers entered the Manor lands, Indians fished the coastal plain streams and hunted the pine and hardwood forests of the interstream areas. The pioneers were quite naturally mainly agriculturists. However, the more sheltered nature of the headwater area of Chesapeake Bay encouraged more fishing to augment the diet than the more open and unfriendly northward shorelines in other colonies. In the coastal plain section the colonists found that they could go almost everywhere by boat. Vessels came to the wharfs, "rolling roads" to the wharfs helped transport the tobacco and other crops from the interior as time and energy gradually coöperated in pushing inland the true farmers.

Hence distribution of population first attained notable density along the coastal rivers. (The town of Joppa for instance, was settled well over two centuries ago. It well deserved the name, whose meaning is "beauty." For many years Joppa reigned the mistress

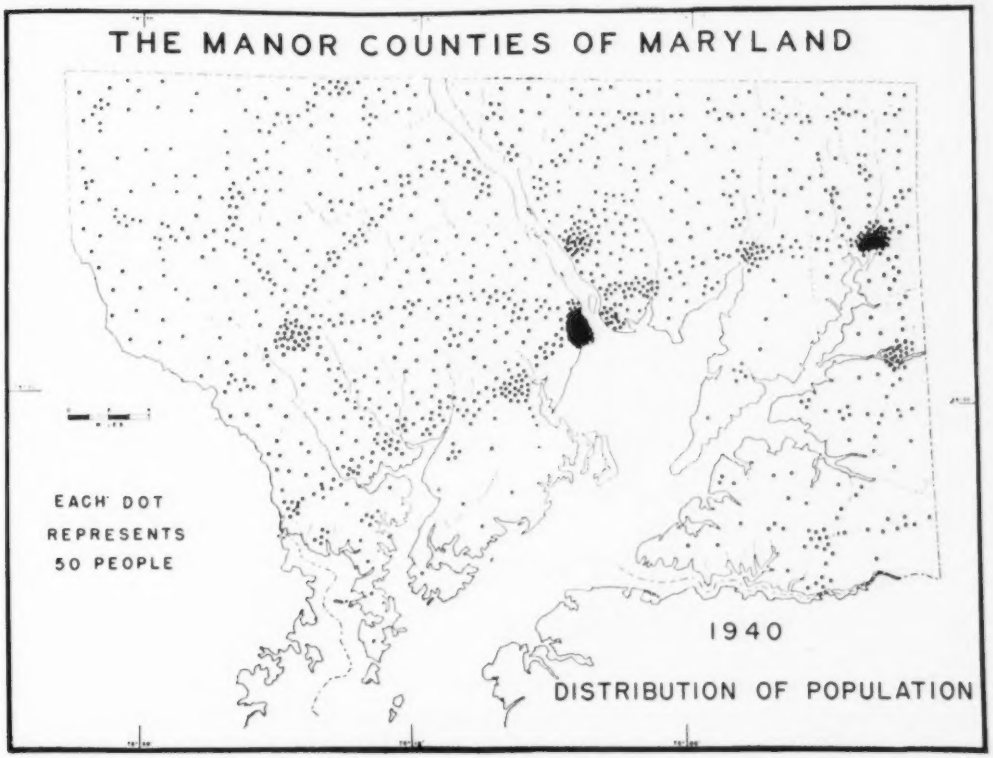

FIGURE 10.—Today's concentration of people and routes of transportation with their accompanying enterprises vary little from the 1870 pattern.

of Chesapeake Bay. In its harbor were vessels from New England, the West Indies and ports of Europe. It became the seat of the social and civil life of the country, and being located upon the public highway leading to the northern colonies, it became a well-known resort for travellers and merchants.) The movements of people were, we might say, at right angles to the coastline, in much the same manner as the ingress has been in the continents of Africa and South America. The outlook was seaward to the farmer and the fisherman. Havre de Grace became a fishing center, then flour and lumber mills sprang up, and sash factories, and later on canneries and textile works.

H. M. Curran in his article, "The Forests of Cecil County," states, "The steady decline of the Forest resources of Cecil County is easily explained. The earliest settlers cleared small areas of level land near the shores of the Bay, and millions of feet of choice oak were cut and burned. Year by year new settlers came and cleared forest land; the older settlers enlarged their fields, and so the forest receded from the more desirable farming regions.

"As the population increased, timber for ships, for buildings, and for export was demanded, and the choicest trees convenient to the water courses were removed. The increase of population led to clearing of all good agricultural land in the county."

Gradually products of the forest were moved along the coastal plain, but not always by boat. As the forests were cleared transverse roads along the level terrain of the coastal plain were started. Search for solid road beds and better building materials led, in a

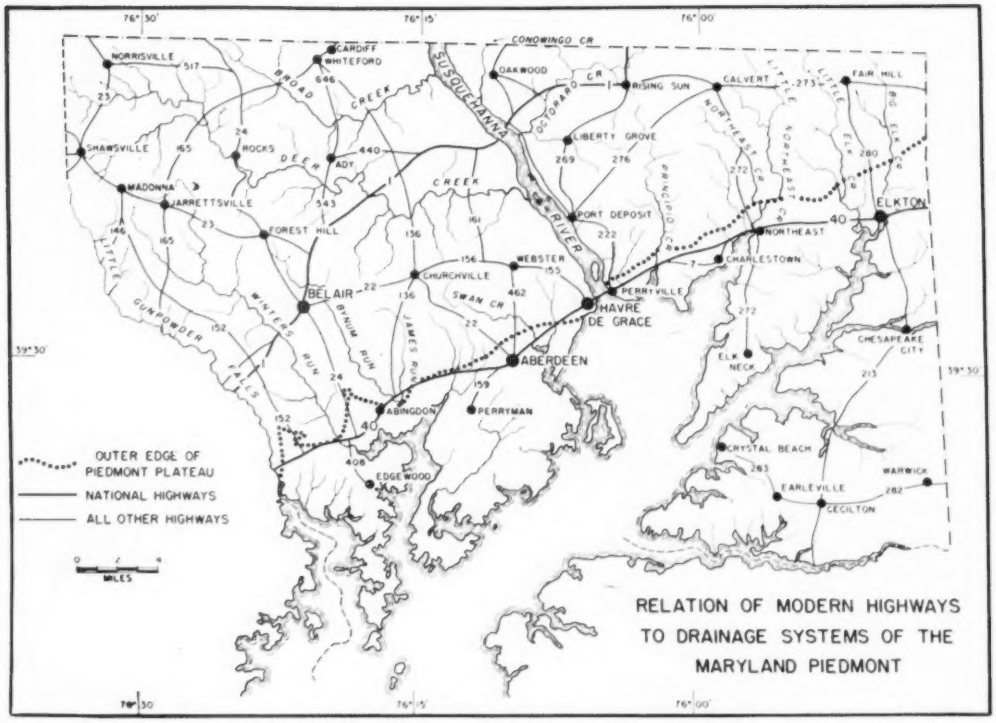

FIGURE 11.—The interfluvial pattern of population is brought out sharply. Note Bel Air, Churchville, Forest Hill; even Elk Neck and Cecilton.

complementary way, to the use of the granites of Port Deposit, and the flint about Castleton. Some of this heavy stone was transported by water, some was carried laboriously over poor roads to Baltimore and Philadelphia.

The Manor Counties were beginning to have their population distributed not only along lines running inland from the shore but also along lines paralleling it. What had been a transition zone was also becoming a transit land. The population pattern was shaping up according to economic factors which had their foundations in the broad streams of the coastal plain, the abundant fish, the broad level lands with their vegetative cover, the streams of the interior which later supplied power for the mills, and the wide interfluvial areas which encouraged, fostered, and prospered the farmers who were willing to clear off the timber. Discovery of building stone in the great dispersal of the population seemed to give the people the firm foundations and the cornerstones with which to locate and erect the great permanent Manor Counties as they stand today.

POPULATION—AND PHYSICAL FACTORS

Use of land has always been associated with geographic factors, but to associate growth, composition and distribution of population with physical factors of a region presents an intriguing and challenging task!

When the coastal plain and piedmont regions of the Manor Counties were first inhabited the two physiographic divisions of themselves guided the spread of the peoples (Figure 5). The level land interspersed with waterways in the coastal plain area had the effect of placing peoples on the water fringes. Even farmhouses were erected with

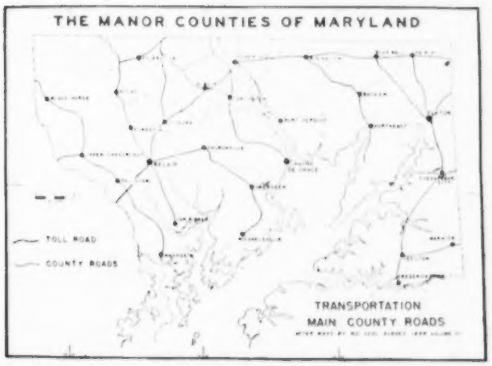

FIGURE 12.—The routes to the interior stand out; see Figures 13 and 14 for the northeast-southwest transportation lines.

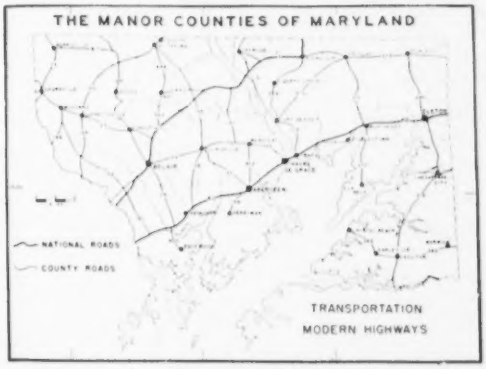

FIGURE 13.—The national highway number one follows the early interfluvial roads; highway number forty skirts the abutments of the Piedmont.

their front doors facing the water nearby rather than fronting on the roads which gradually were built to traverse the flat land between the broad, coastal plain rivers (Figures 6, 18, and 19).

In the Piedmont plateau section, spread of peoples did not hinge so definitely on stream pattern (Figure 11). Here homes occupied high ground of the interfluvial areas (Figures 20 and 21).

Composition of the population, being largely English and Dutch, had direct influence on occupation of various physiographic divisions. Both nation-

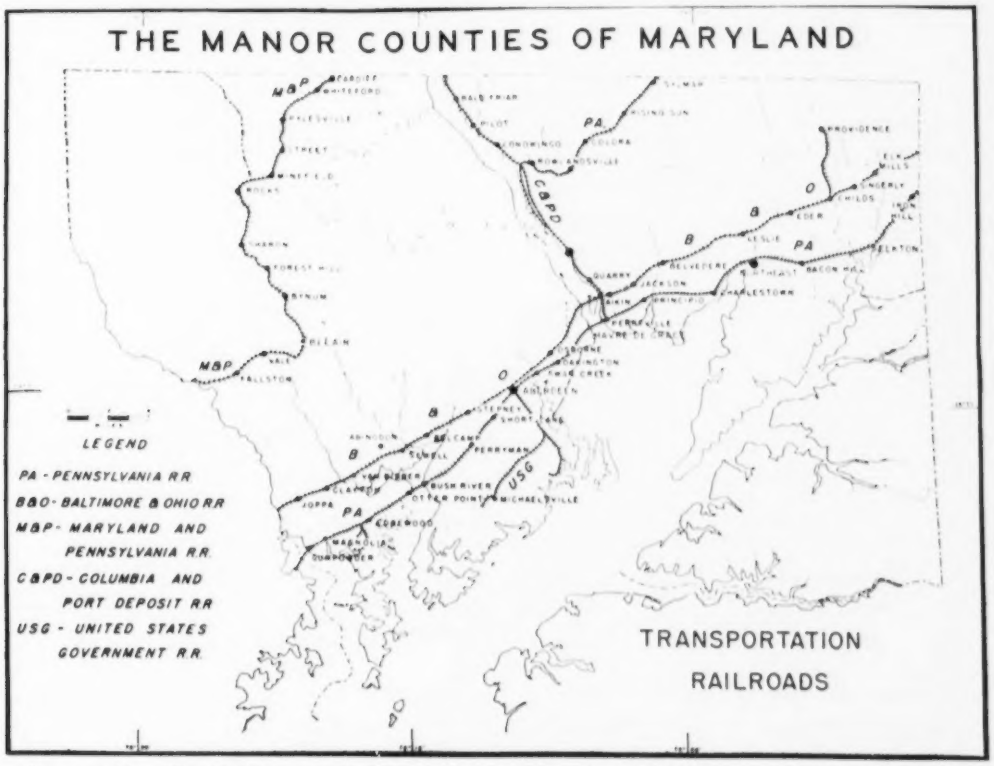

FIGURE 14.—The Baltimore and Ohio, and the Pennsylvania Railroads took advantage of the coastal plains inner edge. Note the winding route of the M. & P. R. R.

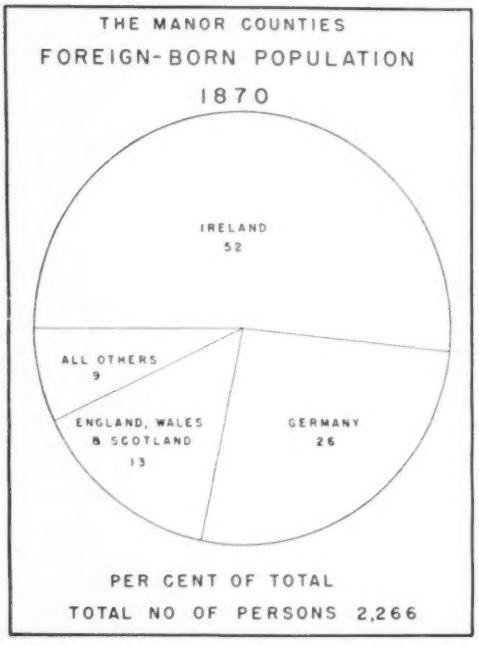

FIGURE 15.—Northwestern Europe leads as a contributor of foreign-born.

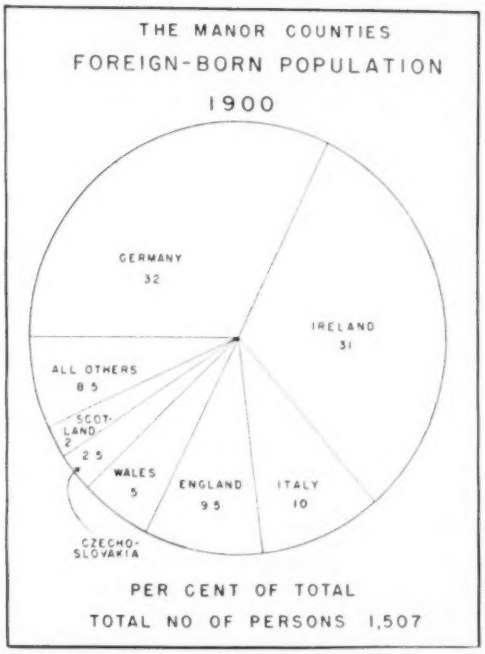

FIGURE 16.—"Whereas Ireland and Germany dominated the immigrant picture in the years 1870 and 1900. . . ."

alities, during that early period, were engaged in farming. The English manors had much to do with the desire to establish manor lands and estates in this area. The physiographic divisions of the area encouraged the desire. The Dutch, many from the fine farm lands of southeastern Pennsylvania likewise wished to carry on in their accustomed occupation; the physical structure of the terrain aided and abetted their wishes.

Climatic characteristics of the region enhanced the terrane attractiveness of the region. The climate charts (Figure 22) reveal that rainfall, although abundant, totals less than the amount received in the British Isles. If a maximum can be distinguished in this rather even distribution it falls in the period of high sun, encouraging farming.

The influence of Chesapeake Bay, with its higher temperatures in winter, and their lowering in summer, is brought out remarkably well in Figures 23, 24, 25, and 26. The consistent curvature of the isotherms and isohyets over the Chesapeake Bay area indicates how the Manor Counties enjoy climatic conditions which ordinarily belong to counties situated much farther south.

The northern boundary of cotton growing is largely one of temperature limitation. Hence cotton plantations and tobacco farms were confined just to the south of the Manor Counties, and as a result composition of people on farm lands thus was kept largely white.

Relation of soils to the density and distribution of population in the Manor Counties bears out quite well the adage that "usually the best farmers get on the best soil." A glance at the soil map (Figure 27) brings out leading areas and soil classification. Chester and Manor soils predominate in the Piedmont plateau region. On such soils are the prosperous and well-established farms. The farmers today are descendants of the initial soil breakers. The

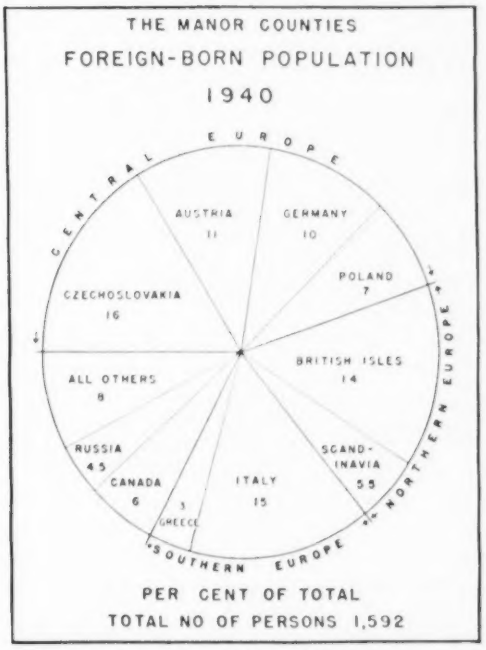

FIGURE 17.—The shift to Central Europe is remarkable in 1940.

Sassafras silt loams and sands of the Eastern shore in the Atlantic coastal plain even today have the manors of yesteryear. The signpost to "Bohemia Manor," located between the Bohemia River and Back Creek (Plate XIX), has this statement, "Patented to Augustine Hermann, 1662, as 5000 acres, for making the mapp of Said Province of Maryland. Here came Charles, the Third Lord of Baltimore in 1682 to meet Penn's representative to discuss the boundary between Maryland and Pennsylvania."

Not far from the "Bohemia Manor" is the "Labadie Tract" comprising 3,750 acres obtained in 1684 from A. Hermann by the religious sect called Labadists. Here they led an austere form of communistic life but disintegrated about 1698.

Concentrations of people along the banks of Susquehanna River and across the northwestern part of Harford County were chiefly caused by discovery of building stone in the areas; granite near Port Deposit and flint near Conowingo; marble and serpentine extending from southwest to northeast across Central Harford County and across the northwestern corner of Cecil County.

In summarizing the roles played by the various geographic factors in the distribution of population, its composition and growth we can only say that the whole story cannot be told until the complete land use picture has been drawn. Nevertheless, the physiographic base of the Manor Counties originally draws the population pattern, the climatic factors color it, the soil casts it into a firm frame, while the biotic resources clothe it in a drapery of life and movement.

CONCLUSIONS

The region of the Manor Counties has manifold fascinations for the student of geography. It represents transplantation of the Old World peoples, customs and cultures of the Old World manors into the New. The Unity of their social and economic problems in Europe is expressed by them in America. To determine whether or not all that the Old World manor stood for in culture and progress could be maintained in our democracy has challenged interpretation and research. To trace political maneuverings of William Penn and Lord Baltimore, to discover driving forces which impelled men to hew the counties out of the primitive forests on

FIGURE 18.—Typical large farm of Eastern Shore.

the shores of Chesapeake Bay have all held great interest for the writer.

The region has one of the nicest adjustments to geographic environment that can be found anywhere. The economic balance of the region, as revealed in the occupation of the people,

FIGURE 19.—Near Charlestown, a resort town now. Note the broad Estuarine River.

is almost model. There has been no eccentric disturbance attributed to mineral wealth or any other preponderant feature. The towns have a commercial, rather than industrial, function. The products of the forest, fields, mines and sea are available to all. True, the sea achieved superiority in the early stages of settlement, but the land finally won out. The sea, however, did not relinquish its influence. It lost its high place as a source of food, but entered rightfully into its role as major avenue of trade.

The location of a protected estuary in which to get a foothold, the food from the sea, the ease of early penetration inland, the myriad of waterways—can one deny that they stood the early settler in great stead?

When watercourses invited exploration to their sources, was it exceptional foresight on the part of the settler when he established his manor at the high spot

FIGURE 20.—Near Dublin, Harford County. General farming, gently rolling Piedmont.

of the broad, interstream areas? Did the sharp, gorge-like cuts of the Piedmont stream control his thinking? It seems highly probable that even though the manor idea was uppermost in the minds of many, that the appeal of the wide, rolling uplands and the repelling influence of the sharp stream sites had profound effect upon those who came to establish new homes.

Again, even if selection of home sites was premeditated, it is highly improbable that knowledge of the fertility of the soils and their potential productivity, and best location for roads was available to the adventurers.

Two universal factors did engage the consideration and attention of the early inhabitants, namely, the land surface and the climatic regime. The relief had its immediate appeal for them and after a period of time the extremely good features of the climate were appreciated and utilized.

FIGURE 21.—Looking to the northwest, one-half mile west of Rising Sun. Typical scene of woodlots, dairy barns, and herds. Note the rolling Piedmont.

The physiographic build of the region encouraged movement inland. Here the coastal plain furnished the doorstep to the main floors of the Piedmont. The transitional nature of the Coastal Plain asserted itself. As time went on, however, transportation facilities along the Coastal Plain exerted their powerful influence. Railways and highways converted the region into a transit land as well.

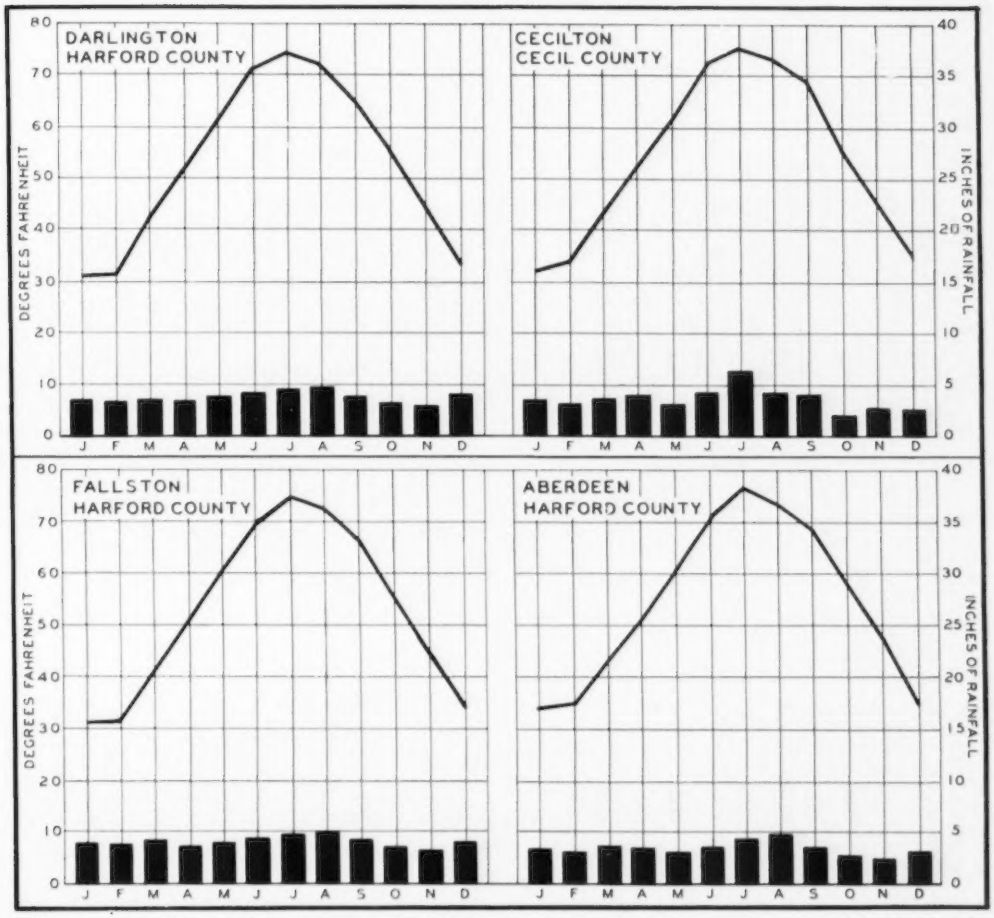

FIGURE 22.—The rainfall, although abundant, totals less than the amount received in the British Isles. The distinguishable maximum falls in the period of high sun.

SUMMARY

1. The growth of population in the Manor Counties has been both gradual and economically sound.
2. The peoples of the manor lands have been widely distributed, due, in part, to the exceptional vision of the original settlers, but more largely, however, attributable to the farming, transportation and commercial features of the region.
3. The native-born population is greatly in the majority. Early increases of foreign-born population came mainly from northern Europe, but after the turn of the last century the central European countries furnished most of the newcomers.
4. The occupation statistics of the people reveal that agriculture, government, transportation and manufacturing employ the majority, with agriculture requiring the attention of about twice as many people as any other. General farming, dairying and truck gardening rank as the leaders.
5. The Pennsylvania and Baltimore and Ohio Railways and the National Highways, Numbers 1 and 40, traverse the

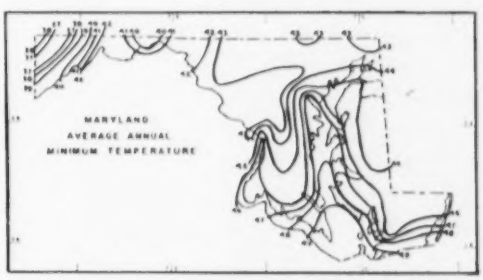

FIGURE 23.—The influence of Chesapeake Bay, with its higher temperatures in winter, and their lowering in summer, is brought out remarkably well.

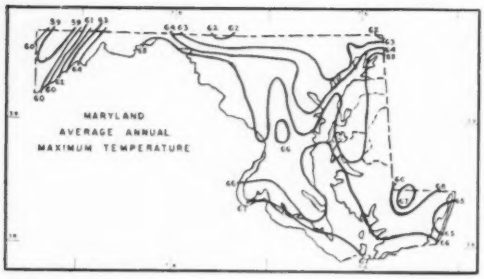

FIGURE 24.—This figure supports the statement under preceding figure, number 23.

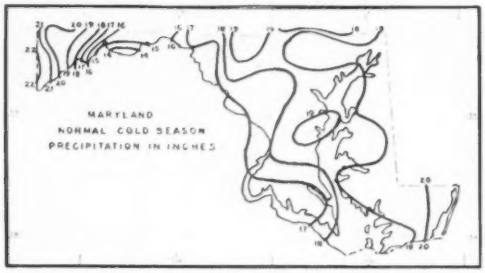

FIGURE 25.—The curvature of the isohyets over the Chesapeake Bay area is consistent with the curvature of the isotherms.

region laterally. Water transportation facilities, particularly by canals, have declined except for the World War II impetus given the use of the Chesapeake and Delaware Canal.

6. Physiographic structure of the counties aided early settlement. Broad coastal-plain inlets, and Piedmont interstream areas furnished the first avenues of travel, and later became the sites of manors.
7. Chester loam, Manor loam, and Sassafras silt loam are the most valuable of all soils. Their extent and quality raise the value per acre to $80.00 and more.
8. Climate, presenting no sharp deterrents to animal and plant life, favored the development of the farm lands. The influence of Chesapeake Bay waters is highly significant.
9. It would be inaccurate to state that one geographic factor to the exclusion of all others determined the growth of the Manor Counties to their present level.

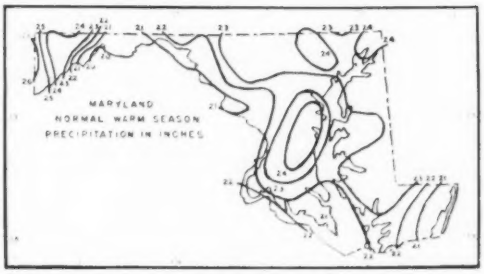

FIGURE 26.—The climatic characteristics of the region enhanced the terrane attractiveness of the land.

Thickness of the cloak of population that covers the area now and pattern of the cloth from which it has been cut

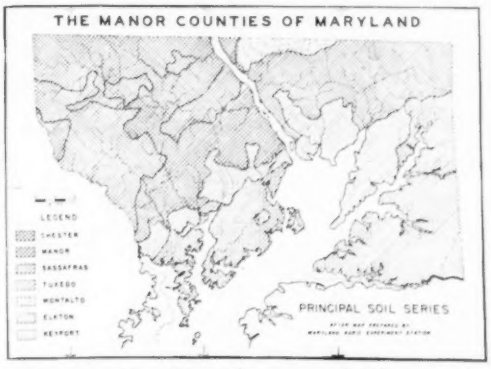

FIGURE 27.—The Chester and Manor soils predominate in the Piedmont; the Sassafras silt loams and sands in the Eastern shore.

indicate that the garment has been woven of fine, durable, home-grown and homespun material of high quality, and gives every indication of continuing so; for the very geographic sources from which the material has been derived are inexhaustible; they have been long before, and will continue far beyond our time—your time and mine!

EROSION IN A WISCONSIN DAIRY COMMUNITY

J. F. Hart

DURING December, January, February, and March, three to five thousand gallons of whole milk leave Wisconsin and Illinois each week, dispatched to one single dairy in Jacksonville, Florida. Six hundred gallons of cream travel the same route weekly all year round. It forms merely one specific example of many that might be cited, of a general movement of whole milk and cream from Illinois and Wisconsin to many points in southeastern United States.

Those who know of the movement have felt that the Southeast might be able to solve a double problem if more of its farmers practised dairying. The whole milk market could be supplied by local dairy farms, thereby improving local economies; and more grassland needed to pasture dairy herds would partly solve the erosion problem which is so serious today. It has been authoritatively stated that "a means of conserving soil and water is planting of more land to permanent pastures, . . . pasture forms such a heavy sod that serious erosion is impossible." Rupert B. Vance has gone even farther in declaring that "agriculture with grass and humus as a means of soil conservation in the South waits on the growth of dairying to become profitable."

It must be conceded that a rotation system, with much land planted in grass, and many new permanent pastures, both adjuncts of a well-balanced dairy economy, would reduce erosion. A dairy economy alone, however, will not solve the erosion problem.

Some evidence in support of this argument is provided by a study of Merton Town (*Town* is equivalent to township, but as the former is the more common name for this minor civil division in southeastern Wisconsin, the term *town* will be used in this paper), a dairy community in southeastern Wisconsin (Figure 1). Of the 146 farms in Merton Town, 132 (92 per cent) are dairy farms (Figure 2), indicative of the importance of dairying to the community.

Of the 22,097.5 acres which comprise the total land area of Merton Town, 14,302.5 acres (64.7 per cent) suffer no apparent erosion (Erosion Class 1; Table 1; Figure 3). (The data in this paper are the result of mapping done by students attending the Northwestern-Syracuse Graduate Field Course, who were being trained in geographic mapping techniques, but not specifically in surveying erosion. Field investigators with more experience in mapping erosion would probably have considered much more of the land more seriously eroded than did the student group. [Cf. R. J. Muckenhirn and O. R. Zeasman, *Soil Erosion in Wisconsin*, Wisconsin State Soil Conservation Committee Bulletin, February 1941, who estimate that only 45 per cent of the Town experiences negligible erosion].) Of the area, 1,927.5 acres (8.7 per cent) are relatively level, poorly drained depressions or swampy areas, in which there is no erosion. At least 5,877.5 acres (26.6 per cent) are areas of glacial outwash deposition, with no appreciable slope, and consequently have not been dissected since melting of the glacier; but, several more severely eroded areas form part of the edges of the outwash where outwash silts and sands have been easily eroded. Although the outwash areas are among the most productive farm lands in the Town

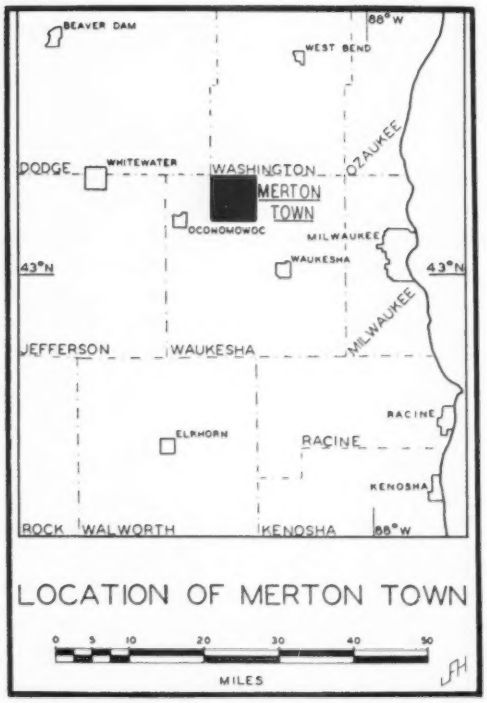

FIGURE 1.—Merton is a typical dairy township in southeastern Wisconsin, west of Milwaukee and a little north, a distance of about twenty miles. Of the 146 farms in the township, 132, or 92 per cent, are dairy farms.

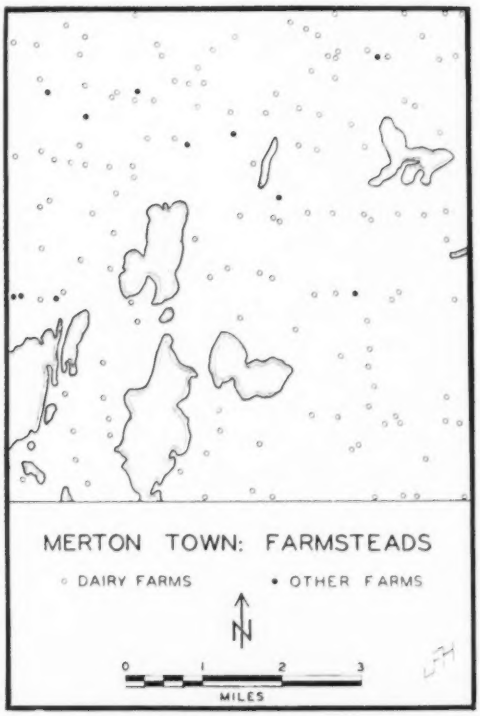

FIGURE 2.—Distribution of the 132 dairy farms and the 14 other farms of Merton township. The importance of dairying in the community is clearly revealed.

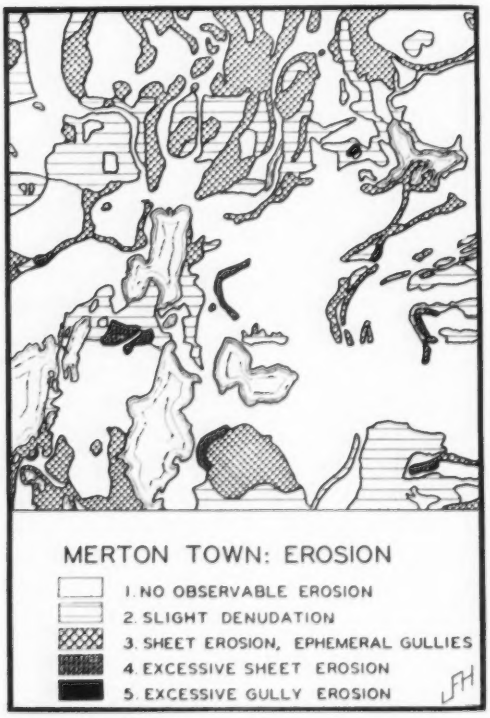

FIGURE 3.—Various degrees of erosion in Merton township are closely related to degree of slope, angle of repose, and texture of soil, and other factors which can be readily evaluated.

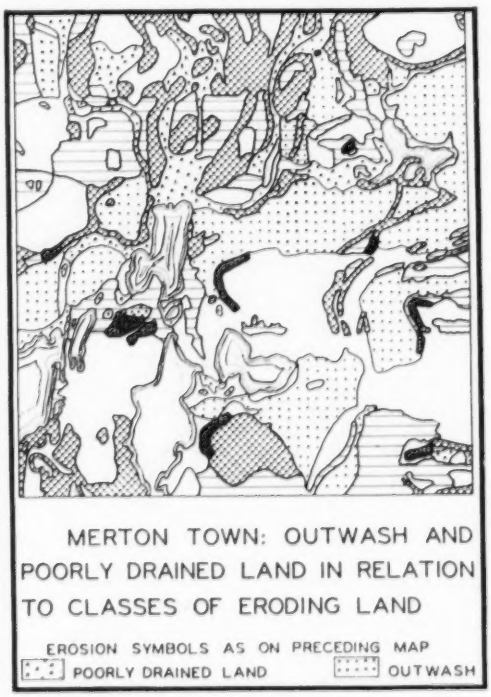
MERTON TOWN: OUTWASH AND
POORLY DRAINED LAND IN RELATION
TO CLASSES OF ERODING LAND
EROSION SYMBOLS AS ON PRECEDING MAP
POORLY DRAINED LAND
OUTWASH

FIGURE 4.—Outwash and poorly drained land in relation to classes of erosion help indicate the factors that play important roles in the character and extent of erosion.

TABLE I

EROSION IN MERTON TOWN, BY CLASSES

Erosion Class	*Acreage*	*Percentage of Total Land Area*
1	14,302.5	64.7
2	3,957.5	17.9
3	3,592.5	16.2
4	227.5	1.1
5	17.5	0.1
Total	22,097.5	100.0

today, they pose tomorrow's greatest potential erosion problems (Figure 4). Thus, 35.3 per cent of the total land area of the Town is not subject to erosion under present conditions, 8.7 per cent because it is too poorly drained, and 26.6 per cent because it is nearly level.

Of the total land area, 3,957.5 acres (17.9 per cent) are in Erosion Class 2, subject to slight denudation, of which largest areas form a broad east-west band in moraine hills of the northern portion of the Town, where stream dissection has prevailed. Other large areas border lakes in the west center of the Town, and along the southern border.

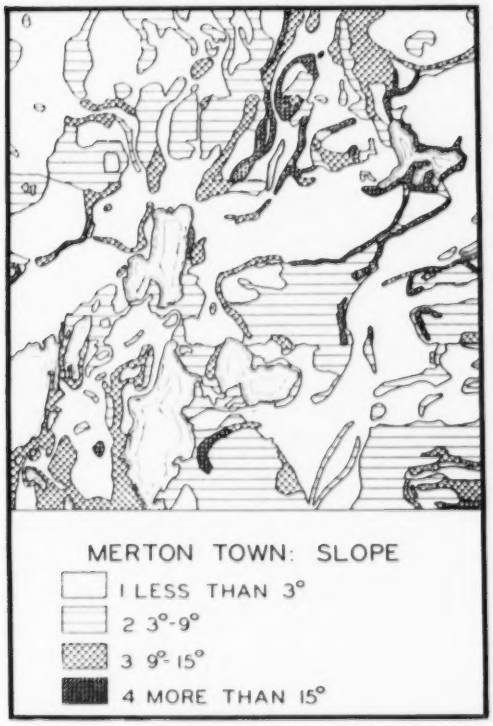

FIGURE 5.—Degree of slope bears close relation to character and degree of erosion, though the angle of repose varies with different types and textures of soil, particularly in relation to torrential rain.

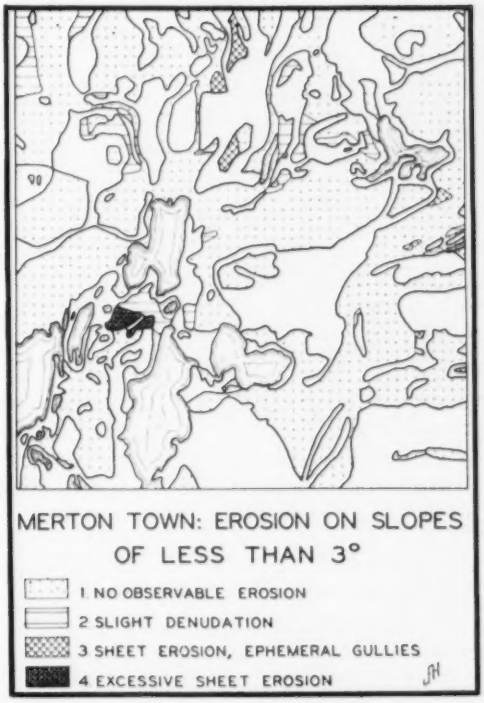
MERTON TOWN: EROSION ON SLOPES OF LESS THAN 3°
1 NO OBSERVABLE EROSION
2 SLIGHT DENUDATION
3 SHEET EROSION, EPHEMERAL GULLIES
4 EXCESSIVE SHEET EROSION

FIGURE 6.—Extent and distribution of various degrees and kinds of erosion on slopes of less than three degrees in Merton township. All kinds of erosion are of relatively slight extent on such low slopes.

Erosion Class 3, or land which has suffered sheet erosion, now has ephemeral gullies, and will deteriorate badly under further tillage. Of the total land area of the Town, 3,592.5 acres (16.2 per cent) are in this class. Dissected moraine hills of the northern part of the Town present best examples. Steep slopes that rim most of the major landforms of the Town include narrow, peripheral bands of land of this class, however, and there are also large areas in scattered sections of the southern part of the Town.

Excessive gully erosion has affected 227.5 acres. In places the gullies are

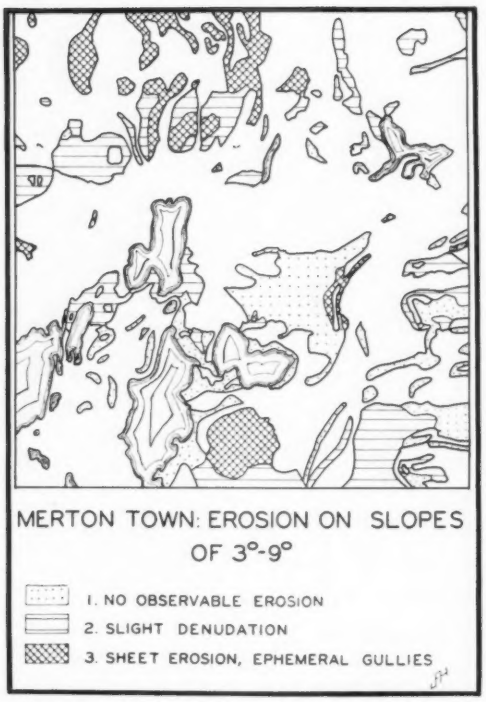

FIGURE 7.—On slopes of from three to nine degrees, sheet erosion with ephemeral gullies becomes fairly significant.

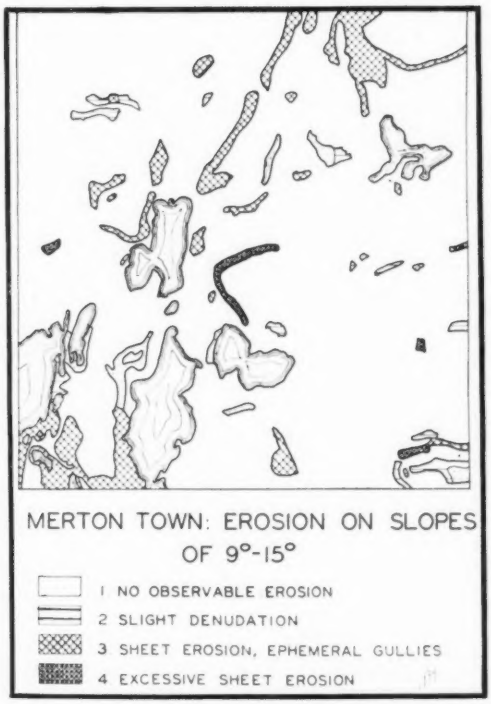
MERTON TOWN: EROSION ON SLOPES OF 9°-15°
1 NO OBSERVABLE EROSION
2 SLIGHT DENUDATION
3 SHEET EROSION, EPHEMERAL GULLIES
4 EXCESSIVE SHEET EROSION

FIGURE 8.—Only scattered and detached stretches of slopes of from nine to fifteen degrees extend from the northeast corner to the southwest corner of the town. Such slopes are rather heavily eroded.

two feet or more in depth (Erosion Class 4). In most cases such areas form merely advanced stages of Class 3 erosion, and invariably they edge major landforms. Only 17.5 acres on the steeper slopes reveal severe gullying (Erosion Class 5). Both classes of severe erosion account for only 1.2 per cent of the total land area of the Town.

Thus, erosion is a problem, a very insidious one, in Merton Town. Only

TABLE II

SLOPE CLASSES IN MERTON TOWN, BY EROSION CLASSES

Slope Class		*Erosion Class*				
		1	*2*	*3*	*4*	*5*
1	Acreage	11,162.5	905	162.5	90	...
	Percentage of total land area	50.8	4.1	0.7	0.4	...
2	Acreage	2,797.5	2,557.5	1,540	...	...
	Percentage of total land area	12.7	11.8	7.2	...	...
3	Acreage	275	322.5	1,442.5	70	...
	Percentage of total land area	0.9	1.2	6.4	0.3	...
4	Acreage	67.5	172.5	447.5	67.5	17.5
	Percentage of total land area	0.3	0.8	2.0	0.3	0.1

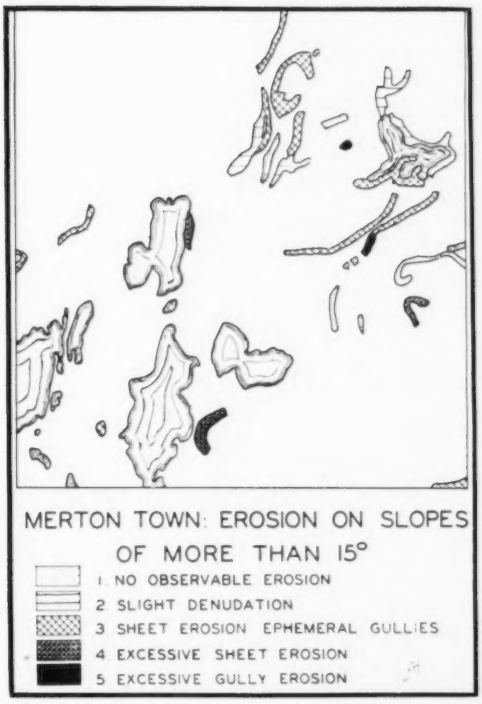
MERTON TOWN: EROSION ON SLOPES OF MORE THAN 15°
1 NO OBSERVABLE EROSION
2 SLIGHT DENUDATION
3 SHEET EROSION EPHEMERAL GULLIES
4 EXCESSIVE SHEET EROSION
5 EXCESSIVE GULLY EROSION

FIGURE 9.—There are only a few areas of Merton township that have more than fifteen degrees gradient in their slopes, and most of these are marked by rather heavy sheet and gully erosion in places.

1.2 per cent of the area is severely eroded; all too frequently erosion is unnoticed until it becomes severe. The trend is already clear. Unless corrective measures are taken, most areas which now suffer sheet erosion with ephemeral gullies (Erosion Class 3) will soon be severely eroded; areas which have thus far suffered only slight denudation will soon be completely eroded. (Illustrative of the complete ignorance of erosion and its control is the farmer who "contour-plowed" his cornfield, *straight downhill!* [Figure 10].)

It would be imprudent to claim similarity of erosive influences in southeastern Wisconsin and in southeastern United States, but there might be some slight similarity of slope conditions. Thus, it may be interesting to discover the extent to which slope and erosion are related in Merton Town, despite the fact that the Southeast is much more dissected (Figure 5).

Comparatively level lands of Merton Town (Slope Class 1, with slopes of less than 3 degrees) reveal almost all degrees of erosion, but most of them have suffered none that is noticeable (Table II). Whereas 12,320 acres (56 per cent) of the Town fall into this class, 11,162.5 acres (50.8 per cent) of the relatively level areas are not conspicuously eroded (Figure 6). Eroded lands in Slope Class 1 are those which lie on the edge of level areas, where initial stages of stream development have begun.

Slope Class 2 (lands with slopes of 3–9 degrees) presents a varied pattern (Figure 7). They represent 31.7 per

FIGURE 10.—Eroded Cornfield: Invaluable topsoil has already been washed away, although the ephemeral gullies, which have cut to the subsoil, will disappear with the next plowing. The owner is under the misapprehension that he has contour-plowed, because he has run his rows *straight downhill!*

cent of the Town's total land area (6,895 acres) and display various degrees of erosion. Most of the land in the northern part of the Town within Slope Class 2 are subject to sheet erosion and ephemeral gullying, with some areas of slight denudation, whereas no obvious erosion characterizes the southern portion. There are some areas in the southern part which have been slightly denuded, however, and one large area of 407.5 acres has been placed in Erosion Class 3 (sheet erosion with ephemeral gullies).

Areas with slopes of 9–15 degrees (Slope Class 3) comprise 2,110 acres (8.8 per cent; Figure 8). They are scattered helter-skelter over the Town, in close conformity with the major landform boundaries. They are dominantly subject to class 3 erosion, although small areas have suffered less or more.

Only 3.5 per cent (772.5 acres) of the total land area slopes more than 15 degrees (Slope Class 4; Figure 9). Such steeper slopes, predominantly the long narrow borders of major landforms, are highly subject to erosion. A few have escaped thus far, but most have suffered erosion ranging from slight denudation to severe gullying.

There is, then, rather close correlation between slope and erosion in Merton Town. Level areas have not been subject to erosion to any great degree, whereas steeper slopes almost invariably show traces of erosion, even if they do not exhibit ugly, eroded gullies.

CONCLUSION

In Merton Town, where dairy economy, dependent on rotational and permanent grass pastures, is dominant, serious erosion problems are nevertheless developing. In contrast, many environmental conditions which characterize the Southeast actively promote erosional processes, and make the problem of erosion control much more difficult than it is in Merton. Thus, the study indicates that widespread introduction of a dairy economy into the Southeast will not achieve complete solution of the erosion problem which now plagues that area.

FIGURE 11.—Steep, Severely Eroded Slope: The steeper slopes in Merton Town, even though permanently planted to grassland, are subject to severe erosion.

BALSA INDUSTRY OF ECUADOR

Merna Irene Fletcher

THE balsa industry of Ecuador is of comparatively recent development. However, it is known that the Inca Indians used balsa some five hundred years ago for making rafts to transport armies and equipment on the Guayas River. By 1911 a few thousand logs annually were being exported, but not until 1936 did balsa become a significant item of trade. With the start of World War II, uses of balsa multiplied, and it became a strategic material of war in construction of 400-mile-per-hour British Mosquito bombers. Air freight service may open a new peacetime use for balsa, the featherweight wood, in the form of packing crates.

Pizarro, sailing along the coast of Ecuador from Panama, saw natives sailing a gigantic raft of pale light wood lashed together with vines. A mast from the center carried a huge cotton lugsail. The craft was being steered in the same manner as balsas on the Rio Guayas are today. It was the highest development of a sea-going craft ever reached by any pre-Columbian people. The Spanish Conquistadores gave it the name balsa, the Spanish word for raft. The Spanish word became the name applied to trees of the genus Ochroma, a tree of the bombax family, as well as to the cellular lumber cut from the trees. Two commercial species of value are found in Ecuador bearing the botanical names *Ochroma lagopus* Sw. and *Ochroma piscatoria*. There are at least a dozen varieties from southern Mexico to Peru. Natives call the tree palo de balsa or simply balsa. In Puerto Rico it is called corkwood or guano. In Martinique they refer to it as floating wood.

THE BALSA TREE

Wild balsa is indigenous to the tropical Americas almost everywhere. Costa Rica (producing increasing quantities), Guatemala, Nicaragua, Colombia, Venezuela, Panama all produce small amounts, but Ecuador controlled 95 per cent of production in 1943. None grows naturally in the United States of America. The Ecuador region around Quevedo, a town midway between Guayaquil on the coast and Quito in the mountains, provides ideal growing conditions for the tree. The region has a damp but well-drained layer of moist topsoil of the jungles along Ecuador's Guayas River and its tributaries.

Mature balsa trees grow to average heights of from 50 to 100 feet, the straight trunk growing for nearly two-thirds of its length without branches or leaves. The tree grows faster than any jungle plant except wild papaya, reaching a height of about 12 feet in one year with diameter of two to two and a half inches. It may be cut when two years old, but the most economical cutting age is from six to eight years when it is 50 to 60 feet in height and two to two and a half feet in diameter. The balsa is a conspicuous tree in the tropical jungle and easily distinguished not only by its light soft wood but also by its large simple leaves, large solitary flowers, and conspicuous fruit. In the Ecuador forests the tree is in bloom in August. The ivory-colored, vase-like flower, six inches in length, stands erect at tips of the branches. Later the blossom gives way to fruit which is not unlike a cotton boll on a large scale—the size of a man's hand. When the fruit is mature but has not yet burst, it looks like a rabbit's

FIGURE 1.—Major Balsa producing areas of Ecuador, and the well-distributed network of streams by which the light wood can be floated to mill or market. Balsa trees grow from sea level to 2,500 feet in elevation in Ecuador. Balsa is becoming a plantation crop in some areas. In 1937, the Ecuadorian government passed a law requiring planting of two small balsas for every tree cut for commercial use.

foot and presumably it is from this resemblance that the first species of Ochroma to be described was given the botanical scientific name *lagopus*.

When the fruit finally bursts, a mass of down like rabbits' fur almost falls to earth. Seeds of balsa are enveloped in the fluffy down which winds from the Andes catch and disseminate. Unlike cotton the "down" is not firmly and permanently attached to the grape-like seeds.

In appearance the tree somewhat resembles the North American cottonwood (*Populus deltoides*) while the wood resembles clear white pine (*Pinus strobus*) or basswood (*Tilia americana*). It is closely related to the ceiba or silk-cotton tree.

The wood is sometimes pinkish white or pale reddish and sometimes tinged with brownish color, but always has silky lustre and velvety feel. It can be dented easily with the fingernail. It has uniform spongy texture due to the very small percentage of actual wood fiber per cubic foot. The very thin cell walls filled with air produce the spongy texture. The cells are almost parenchymatous. Dried balsa weighs only half as much as cork and has much greater utility. While cork is only the bark of the Spanish oak, with balsa the whole tree is used. Its strength is half that of spruce, while its modulus of rupture equals 2,100 pounds per square inch and its crushing strength, 2,150 pounds per square inch; hence its lightness does not impair its strength. It is the lightest known wood having sufficient strength and stiffness to be commercially useful. (See Table III.)

PHYSICAL REQUIREMENTS OF BALSA

Climatic records for the lowland region between Guayaquil and Quito are scarce but adequate statistics are available for both Guayaquil and Quito. Most of the Guayas-Daule-Vincas basin which provides about 65 per cent of the balsa cut in Ecuador is tropical. Only two seasons are recognized. The rainy season or *invireno* which extends from December to May or June is broken by a short period of dry weather called the veranillo (little summer) shortly after the December solistice. Otherwise it rains every day, streams overflow, land traffic is interrupted, air is drenched with moisture and becomes oppressive. The dry season called *verano* or summer, which extends from June to November is also broken by a short rainy spell called the *inviernillo* (little winter) or "*cordonazo de San Francisco*" which follows the September equinox. Apart from the *veranillo* and *inviernillo* the two recognized seasons are sometimes broken by cloudless skies in winter and by drizzling mist called the *garúa*, or by

frequent dense morning fogs in summer.

Mean temperature in winter is about 80° to 82° on the plain. Mean summer temperature is about 77°. Annual range is from 66° to 95° depending on elevation. Near the coast, heat is modified at many points by the cold Humboldt current which sweeps up the west coast of South America. (See Table IV.)

Rainfall varies with elevation and latitude, becoming heavier toward the mountains and northward. Average annual rainfall at Guayaquil is slightly less than 40 inches, while at Quevedo, center of balsa production, it is 100 inches.

High winds and lightning are infrequent. Prevailing winds blow from the Andes. Earth tremors are felt frequently and disastrous earthquakes have occurred.

To be best suited for balsa, soils should be sandy and well-drained with a heavy layer of topsoil, which with heavy rainfall insures the rapid growth which gives balsa wood its singular lightness.

FIGURE 2.—Balsa tree about two years old. September 20, 1943. Estacion Experimental Agricola del Ecuador. (Photo: Mitchell.)

FIGURE 3.—Balsa tree being cut for lumber. September 26, 1943. Near Quevedo, Ecuador. (Photo: Springfield.)

DISTRIBUTION OF BALSA IN ECUADOR

Trees grow on coastal regions from sea level to 2,500 feet. They line banks of the Guayas, Babahoyo, and Daule Rivers and their tributaries. They are found along the Rio Verde, Esmeraldas, Chone and other streams which penetrate the hinterland.

They are more abundant as second growth where clearings have been made by nature or cultivation. Natural seeding produces so many young plants as to suggest weeds, so the tree is sometimes known as the "weed tree." Its prolific nature makes it difficult to estimate accurately the volume of balsa available.

The Santo Domingo region (15′ S. 79°10′ W.) in the Province of Pichincha has virgin forests untouched. Also in El Oro (3°10′ S.), southeast of Guayaquil, where there are a great many trees there has been very little cutting. At present about 65 per cent of the balsa cut comes from the area around Quevedo,

in the Province of Los Rios, two days' travel up the Guayas from Guayaquil, where plantation balsa is produced in addition to wild growth. The area surrounding Esmeraldas in the extreme northwest of the country provides another 25 per cent of commercial wood. A third producing area is found in Manabi Province along the coast in a semicircle from Manta to Santa Ana and north to the coast again.

In 1937 the Ecuadorian government passed a law requiring planting of two small balsas for every tree cut for commercial use; a future supply is thus assured.

Plantations are started by cutting the virgin forest and firing it much as the natives do when they plant their garden patches. Seeds are placed in bamboo tubes four inches in diameter set upright in the ground. When the plant is four or five inches high it is ready to transplant to the open field. In one year it may attain a height three times that of an average man. After it is planted, the jungle undergrowth is not cut, to force the tree to fight for light; hemmed in on all sides, the tree has to shoot up out of the dark and damp toward the sun.

EXPLOITATION AND MILLING

At present balsa trees are cut by hand, the workman using the broad-bladed ax called a machete. The bark is removed at once and the end of the log "sniped," or pointed. Just above the point a groove is cut into which a chain or rope is fitted to drag the log to the river. Bullocks are used commonly to drag logs to the rivers. Logs are cut only a few weeks in advance of milling and shipping because exposure induces deterioration. Until the war, natives were getting five sucres (sucre about 5–7 cents) for a balsa log 20 ft. by 2 ft. in diameter. At the same time a model airplane in the United States sold for fifty cents. It consisted of a piece of balsa approximately 8 x 10 inches.

Practically all logs are rafted down rivers to mills at river ports. In many cases huts are built atop the raft and raftsmen pick up agricultural products along the way to take to coastal markets. The Guayas River provides outlet for balsa from Quevedo to Guayaquil. In the northwest the Esmeraldas River is used to the port of the same name. In Manabi province balsa goes by the Rio Seco de Manta to Manta and by the Rio de Chone and its tributaries to Bahia de Caráquez during the wet season and by rail or truck to Manta during the dry season.

FIGURE 4.—Balsa bark being removed from log before shipment to the sawmill. The bark is slashed with axe and machete then peeled off with sharp poles. September 26, 1943. Near Quevedo, Ecuador. (Photo: Springfield.)

The principal sawmills are located at Guayaquil with others also in Esmeraldas, Manta, Rio Verde, Bahia de Caráquez, Borbin, and Limones. Most mills

are provided with circular saws to cut logs into boards and planks. After sawing, the lumber must be thoroughly dried, by kiln or sun. Most leading producers kiln-dry balsa immediately after sawing to minimize decay. Kiln-drying requires from three to ten days. Sun-drying in the dry season takes about twenty days and much longer during the rainy season.

FIGURE 5.—Balsa log rafts at the sawmill in Guayaquil. These rafts are made of logs cut far up the Guayas River and are floated downstream and on the tide with loads of produce and livestock. September 23, 1943. "American" Sawmill, Guayaquil, Ecuador. (Photo: Mitchell.)

Mill capacity is sufficient at present to handle all logs cutters are able to supply. Approximately 25 per cent of logs delivered are defective, apparently undetectible until the log is cut. Some are water-logged due to structural change of fibers during growth. Others contain worm holes and other defects that make them unsuited for commercial use.

FIGURE 6.—Balsa logs loaded on truck for shipment to sawmill. September 26, 1943. Near Quevedo, Ecuador. (Photo: Springfield.)

The United States Office of Economic Warfare introduced an orderly grading system—A, B, C and shorts—at the Ecuadorian sawmills, to enable ships to load at Guayaquil with lumber for a U.S. destination without second sorting and consequent rejects and final processing there.

MARKETING BALSA

Very little balsa cut in Ecuador is used domestically. Practically all is exported. Before the war nearly all went to the United States. From 1935 to 41, Ecuador supplied 99 per cent of the balsa needs of the United States and Great Britain. Costa Rica, Guatemala, Nicaragua, Colombia, Venezuela, and Panama all produced small quantities during the period. Costa Rica is producing increasing amounts.

TABLE I

EXPORTS OF BALSA

Year (Average)	*Lumber (1,000 lbs.)*	*Logs (1,000 lbs.)*
1911–15	(1)	22
1916–20	(1)	18
1921–25	(1)	425
1926–30	....	952
1931–35	503	928
1936–40	2,709 (2)	1,883
Annual		
1941	....	10,348,000
1942	....	19,863,000
1943	....	30,119,000
1944	....	20,558,000

(1) Included with other woods. (2) Three-year average 1936–38

During the war the United States absorbed 90 per cent of the total shipped and the United Kingdom took practically all the rest for use in airplanes. Peru took the remainder. Balsa obtained shipping priority and moved freely from all ports, because of its strategic character.

According to the Pan American Yearbook for 1945, Ecuador's balsa exports

in 1943 were valued at 43,418,722 sucres, or about $3,000,000 which gave balsa rank of third most valuable export of the country for the year.

According to the 1944 report on Foreign Commerce and Navigation of the United States the following imports of balsa were made in 1944. (Table II.)

TABLE II

UNITED STATES IMPORTS OF BALSA

Country	*Balsa (1,000 board feet)*	*Dollars*
Ecuador	52 (logs)	2,454
Mexico	34 (sawed boards)	3,145
Guatemala	1,087 " "	93,545
Nicaragua	52 " "	3,174
Costa Rica	1,990	194,642
Colombia	1,284	100,411
Ecuador (1)	3,438	268,180
Ecuador	25,759 " "	2,023,120
Chile	132	11,256
Total	33,776	2,697,475

(1) Free under Executive Order #9177.

Demands for the wood for wartime uses began to decline soon after mid-1944. However, it is expected to continue in more demand than before the war.

LABOR SUPPLY

In the coastal region where rubber and balsa are collected, an area comprising 30,000 square miles, the population is estimated to be 550,000, an average of 18 per square mile, a high ratio as compared to the moist tropics elsewhere. It provides a fair quota of agricultural laborers. Nevertheless, Ecuador has a labor problem. When the chief crops of the region—cacao, bananas, sugar, rice—are being harvested during March, April, and May, shortage of laborers ensues. Then balsa enterprises must compete for workers. There is also severe competition with rubber tapping and cinchona bark gathering.

At the present time, the balsa industry must compete in such a deficient labor market. Although there are possibilities for recruiting labor among certain Indian tribes and other population groups, much work will be necessary before any significant additional labor force for balsa enterprises can be secured. However, certain districts in the Province of Manabi, which exports considerable balsa, are inhabited by descendants of industrious Cara tribes. Limited increase in numbers of laborers from the tribes is possible.

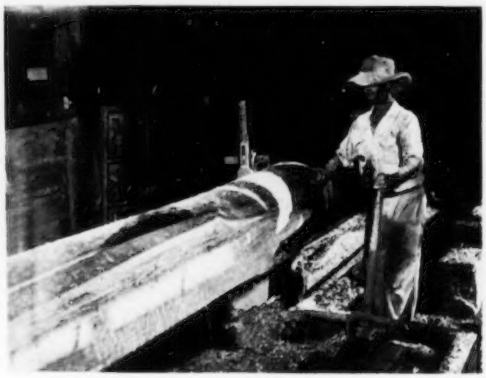

FIGURE 7.—Sawing Balsa logs is difficult, despite the softness of the wood. It is fibrous and the logs are usually wet. September 23, 1943. "American" Sawmill, Guayaquil, Ecuador. (Photo: Mitchell.)

There is common belief that health of Andean laborers when transferred to the less invigorating climate of coastal lowlands is affected adversely, so the labor is not available to the coast. The Indian population of the coast is not large and cannot be depended on to furnish laborers in numbers.

In the provinces of Guayas, Manabi, and Esmeraldas there are estimated to be about 7,000 African Negroes who are drawn on to some extent to serve the balsa industry.

USES AND FUTURE OF BALSA

Because of its extreme levity, buoyancy, strength, resiliency and insulating properties consequent upon cellular structure, balsa serves many uses.

In the regions where it grows, so far as

is known, it has been used by the Indians for 500 years for making rafts to transport goods on the Guayas and

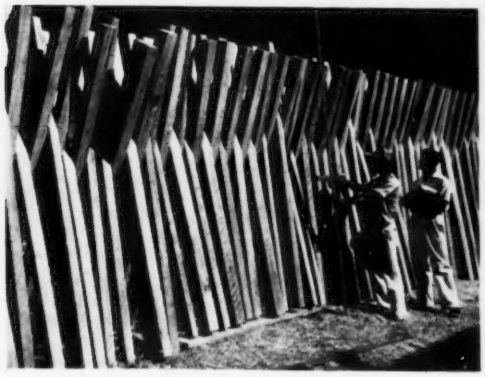

FIGURE 8.—Balsa drying in the sun. This lot is getting final inspection before shipment to England for wooden airplane construction. September 23, 1943. "American" Sawmill, Guayaquil, Ecuador. (Photo: Mitchell.)

other rivers. Little other use was made of it until in the 1930's the role of the cellular wood in industry became increasingly important. It first became a significant item of export trade in 1936. Previously its chief industrial uses were for toys and in manual training schools where it was used for cutting into model airplanes, toys and other models. Other uses in minor quantities included loud speakers for radios, sound proof construction, and movie props.

Because of its extreme buoyancy, about twice that of cork, it is admirably suited to making life preservers, life floats, swimming belts, pick-up buoys, submarine mine floats, pontoons, and surfboards.

Other important industrial uses of balsa wood are based on its insulation against heat and cold. It is ideal as an insulator in incubators, truck bodies, holds of ships, refrigerators, and cold storage rooms, since it is odorless and offers resistance to absorption of moisture. Its lightness combined with its high insulating power makes it extremely valuable as material for constructing various containers for dry ice transportation.

During the war balsa used as plywood became a strategic material in construction of the mosquito bombers previously mentioned. That used in airplane construction had to pass more stringent inspection than wood used for life saving equipment. Toward the end of the war sheets of balsa were bonded firmly with sheets of aluminum alloy for extremely light airplane construction. For use in naval rafts or floats the wood must be covered with water-proof material to prevent its becoming water-soaked. Airplane manufacturers use it for fairings in planes. Commercial planes make use of it for the inside walls in passenger compartments because of its lightness and strength, combined with sound-and-vibration-absorbing qualities.

Its resiliency makes it an excellent

FIGURE 9.—Balsa for export on the dock at Puerto Bolivar. August 12, 1943. El Oro Province, Ecuador. (Photo: Mitchell.)

shock absorbing material. Combined with resiliency is strength and compactness, of the smooth soft-surfaced wood. Because of such qualities a major use as protective packing against shocks and jars of shipping has developed. Balsa pads are used for packing pianos, finely finished furniture, radios, sensitive instruments, fragile ceramics and similar

TABLE III

COMPARATIVE WEIGHTS OF WOOD PER CUBIC FOOT

Balsa	7.3 lbs.
Cork	13.7 "
White pine	23.7 "
Cypress	28.0 "
Sycamore	35.5 "
Red oak	40.5 "
Maple	43.0 "
Hickory	54.2 "
Lignum-vitae	71.0 "
Black ironwood	81.0 "

articles. As foundation pads they are also used in factories to absorb vibration of machinery.

Balsa lumber is expected to be more in demand than before the war. Its use for smaller planes, gliders, and life-rafts will continue. There is likely to be an even greater demand for its wood for model plane construction. It has a future in all the previous mentioned uses, and some additional. One promising field is as a new type of "fill" for an extremely light tennis racket.

With increased air transportation, brightest future for balsa lumber would seem to be in the box industry. Its feather weight wood is ideal packing case material for the air freight service. To save tonnage it will form packing crates for shipment of many commodities by air. The cargo plane has created demand for a new type container for such shipments and balsa appears to supply it.

The present uses for balsa fall into three major classifications: (1) aircraft construction, (2) buoyancy apparatus—floats, rafts, pontoons, etc., (3) toys, model planes, etc. A fourth, the box industry or packing crates for air freight, will no doubt develop. Each use broadly speaking, requires a specific grade of balsa.

Ecuador owes its leading position in the balsa industry to favorable natural growing conditions and inexpensive labor for cutting, collecting, and shipping it. As a result of the war and largely through efforts of the United States many new methods of inspecting, grading and handling balsa wood have been introduced. Balsa plantations are a new development and assure future supply. Such plantations take advantage of abandoned banana lands where balsa thrives as second growth on old clearings, and provides logs of greater uniformity than the jungle.

Although the peacetime demand for some forest products of Ecuador will probably be only a small part of the expanded wartime production, future outlook for balsa seems promising.

COMPARATIVE CLIMATIC DATA FOR GUAYAQUIL AND QUITO

TABLE IV

	Guayaquil	*Quito*
Elevation	39 ft.	9350 ft.
Ave. temp. year	78.3°	57.2°
Coolest month	75.4 (July)	56.6 (July)
Warmest month	80.4 (April)	58.0 (October)
Annual range	5°	1.4°*
Precipitation	38.4 annual	43.1 annual
Wettest month	10.5 (February)	7.2 (April)
Driest month	0.0 (August)	0.8 (July)*

*Quito has a daily temperature range of 23.5 and extremes of 79 to 35. The mean relative humidity is 72 per cent. No similar statistics are available for Quevedo in the heart of the balsa country.

RESOURCES OF THE DUGWAY AREA, UTAH

Ronald L. Ives

UNTIL about 1930, the Dugway area of Utah, located in the west-central part of the state, between the Cedar Mountains, the Simpson Mountains, the Deep Creek Mountains, and the Salt Flats, was commonly regarded as an impassable desert area, without resources or inhabitants, and devoid of present or potential economic possibilities.

This widely-held view was never strictly correct, for a number of ranchers, living under pioneer conditions, have been able to subsist in this "barren" desert for more than half a century. Recent thorough exploration of the area has demonstrated that it has some present economic value, and very definite possibilities as a producer of range products, minerals, and specialized crops.

Location and Accessibility

The Dugway area occupies approximately the central part of the southern half of Tooele County, Utah, and may be reached by improved roads from Timpie, Faust, and Tooele (Figure 1) as well as by a desert road, following the old Pony Express trail from Faust through Fish Springs and Callao to Gold Hill. Although all the roads are subject to closure for several days at a time, due either to snow or mud, the closures are rarely simultaneous, so that the area is seldom isolated for more than 48 hours at a time, despite the 40-mile distance to the railroad. Principal trading centers are Tooele and Grantsville, both connected by rail and paved highways to the Salt Lake City area.

Topographic Summary

Terrain, in the Dugway area, is considerably more complex than indicated by topographic maps. Many of the more interesting features are result of Pleistocene flooding of Salt Lake Desert, for which the first evidence was found by Escalante, in 1776. History of the ancient lakes has been competently described by G. K. Gilbert in his monograph "Lake Bonneville."

For purposes of this study, terrain may be divided into mountains, pediments, clay flats and salt flats. The mountains are composed of faulted blocks of very old sediments and metasediments, with some later intrusive rocks, and some very recent (perhaps post-glacial) extrusives. A typical mountain in the Dugway area, and its relation to the clay flats, is shown in Figure 2. Note here the ancient shorelines in the side of the mountain, the extreme flatness of the clay flats, which are old lake-bottom deposits, and the sparse growth of sage.

Pediments consist, in large part, of deposits of wash from the mountains. They are of various dimensions and composition, but most of them consist of large angular rock fragments in the upper parts, and finer-textured debris at points lower down the slopes and farther from the origin. Some pediments comprise only a thin veneer of debris over a bedrock basement, and hence are identical in form with McGee's original description: others are of great thickness, and are deposited over lake

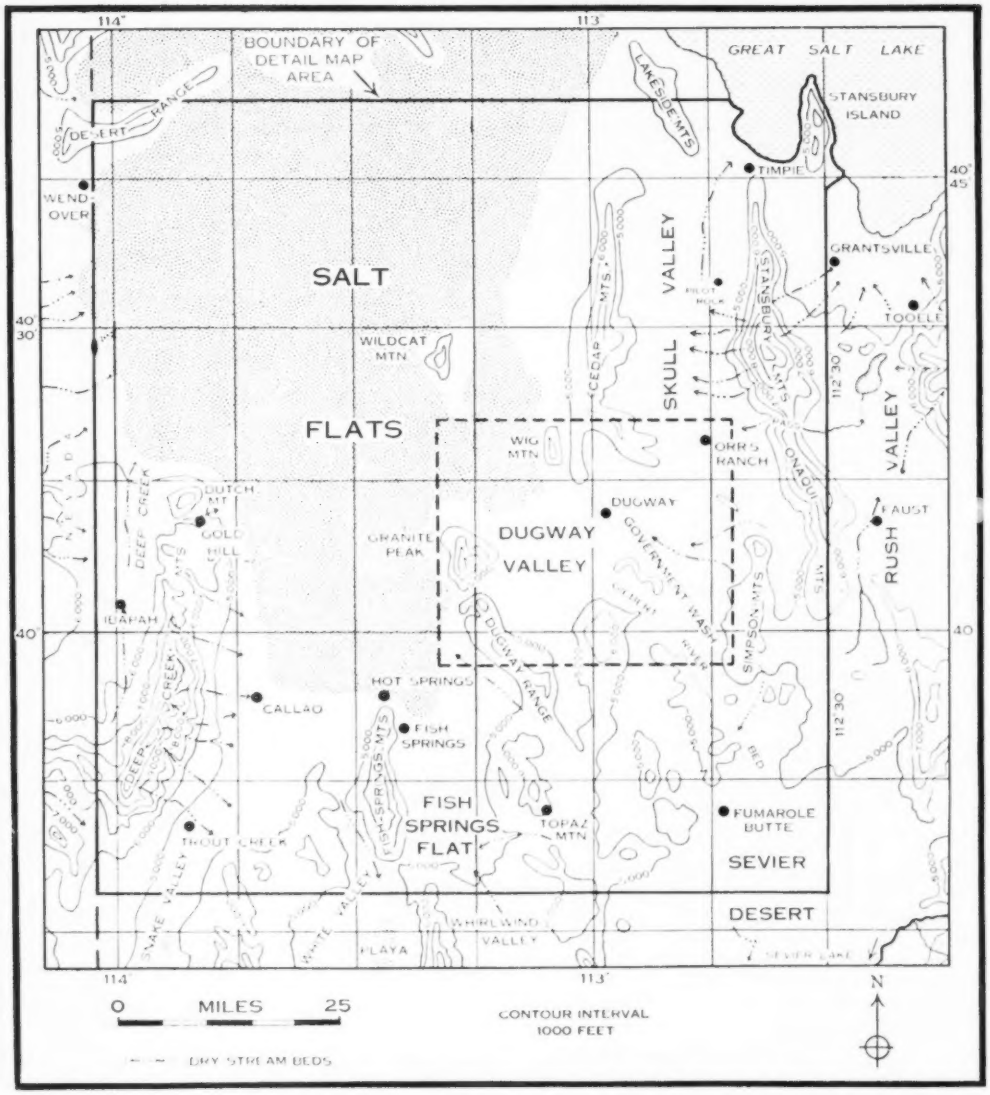

FIGURE 1.—Topographic map of the southern Salt Lake Desert, showing relation of the Dugway area to major physical features and settlements.

bed clays and other sediments of the valley floors.

Relation of pediments to both mountains and valley floors is shown in Figures 3 and 11. Included with pediments here are miscellaneous valley fill and flood deposits of similar origin and nature.

The clay flats are old lake bottom beds, composed of dense, saline, bentonitic clays, with some admixture, particularly near the mountains, of sand and gravel. Level clay flats are shown in Figures 2 and 3. In a few locations, where recent runoff has been voluminous, or where a channel is "inherited" from a previous geomorphic regime, the clay flats are deeply channelled, as at the Gilbert River Bed (Figure 1). Such a channel, now dry at most seasons, is shown in Figure 4.

The Salt Flats (Figures 9 and 11) are a vast expanse of white saline material,

FIGURE 2.—Camelback Mountain, about four miles south of Dugway, as seen from the clay flats to the north. This ridge of sandstone is about 1,000 feet high, and is marked by ancient shorelines. Note sparse sage growth on the clay flats in the foreground.

consisting of impure sodium chloride, mixed with varying amounts of kaolin, bentonite, marl, and diatom skeletons. In some places, the salt is pure enough so that commercial salt production is possible: in most places, the salt content is only enough effectively to inhibit growth of vegetative cover. Many square miles of the Salt Flats are absolutely level, so that the area has been used as race track, and as proving ground for various military devices.

A very few small areas of black and brown loamy soil, of great fertility, distinguish some valleys. They are found either above the Bonneville shoreline (ca. 5200′, MSL) or behind ancient lake-bars which have obstructed the normal outflow from the valley.

CLIMATE

Climate of the area is typical of a middle latitude, high altitude desert, as might be expected from its location. As is common in such regions, temperature distribution is quite uniform from place to place, and from year to year, but precipitation, particularly during the summer months, is very "spotty" and erratic. Climatic charts for three stations in the southern Salt Lake Desert, for the year 1944, are shown in Figure 5, with the record for the same year, and the 75-year average, for Salt Lake City, for comparison. The charts show plainly annual and areal variations in rainfall, and consistency of the temperature variations.

Not only is precipitation in the area scanty, and agriculturally unfortunate in its distribution, but evaporation, particularly during the growing season, greatly exceeds rainfall. There being no official evaporation station in the area under consideration, a number of "spot checks" of evaporation were made with the Lehi station, operated by the U. S. Weather Bureau. They showed that evaporation, at the times checked, was somewhat greater in the Dugway area than at Lehi. Evaporation and rainfall records, for the year 1944, at Lehi, comprise Figure 6. In only four months, at the station, is potential evaporation less than actual precipitation. In the Dugway area, a similar situation prevails, but net loss by evaporation is probably somewhat greater. It should be specifically noted that greatest evaporation, and greatest

FIGURE 3.—Aerial view westward across the Dugway Valley, showing valley floor (foreground), pediments (at base of nearer mountains), the Dugway Range (nearest), the Fish Springs Mountains (middle distance, left), the Deep Creek Mountains (right horizon) and the Snake Range (center distance—this range is in Nevada).

cumulated rainfall deficit (rainfall minus evaporation), both fall in the growing season for most crops.

Local residents, noting decline in the level of Great Salt Lake, have become increasingly alarmed, in recent years, about supposed increase in regional aridity. The alarm was justified during the period 1914–1932, when local rainfall, as well as lake levels, was consequent upon diversion of inflow for irrigation purposes. Because of the inflow diversion, use of the level of Great Salt Lake as a convenient aridity index should be discontinued.

Wind speed and direction, near the surface, depend upon local terrain conditions. At Dugway, the dominant wind, two meters above the surface, is from north-northwest, blowing 25 miles in

FIGURE 4.—The north (downstream) end of Gilbert River bed in the Dugway Valley. Here, because of augmentation of local runoff by a former outflow from the Sevier Desert, the lake bed clays were channeled in Pleistocene times. Recent erosion has fretted the edges of this ancient channel, and has filled the bed with a few feet of sand and gravel. Granite Peak is at the extreme left; Wildcat Mountain to right of channel; and Wig Mountain is in right distance. Most distant mountains are more than 70 miles from camera, north of Wendover.

decreasing. At present, however, according to records of the U. S. Weather Bureau, rainfall is increasing slightly, and regional aridity is declining. Index of aridity for the Salt Lake area, from 1872 through 1946, computed from official figures, is shown in Figure 7. It should be apparent, from the figure, that regional desiccation is not an immediate problem. Continuing decline in the level of Great Salt Lake is in large part

five hours on a sample day. In contrast, the prevailing wind—that most often reported—was from southeast, blowing 23½ miles in six hours on the same day. Wind rose for the sample day comprises Figure 8. At higher levels, wind speed increases, and direction trends clockwise, so that, far aloft, prevailing and dominant winds are westerly with speeds exceeding, and usually greatly exceeding, 30 miles per hour.

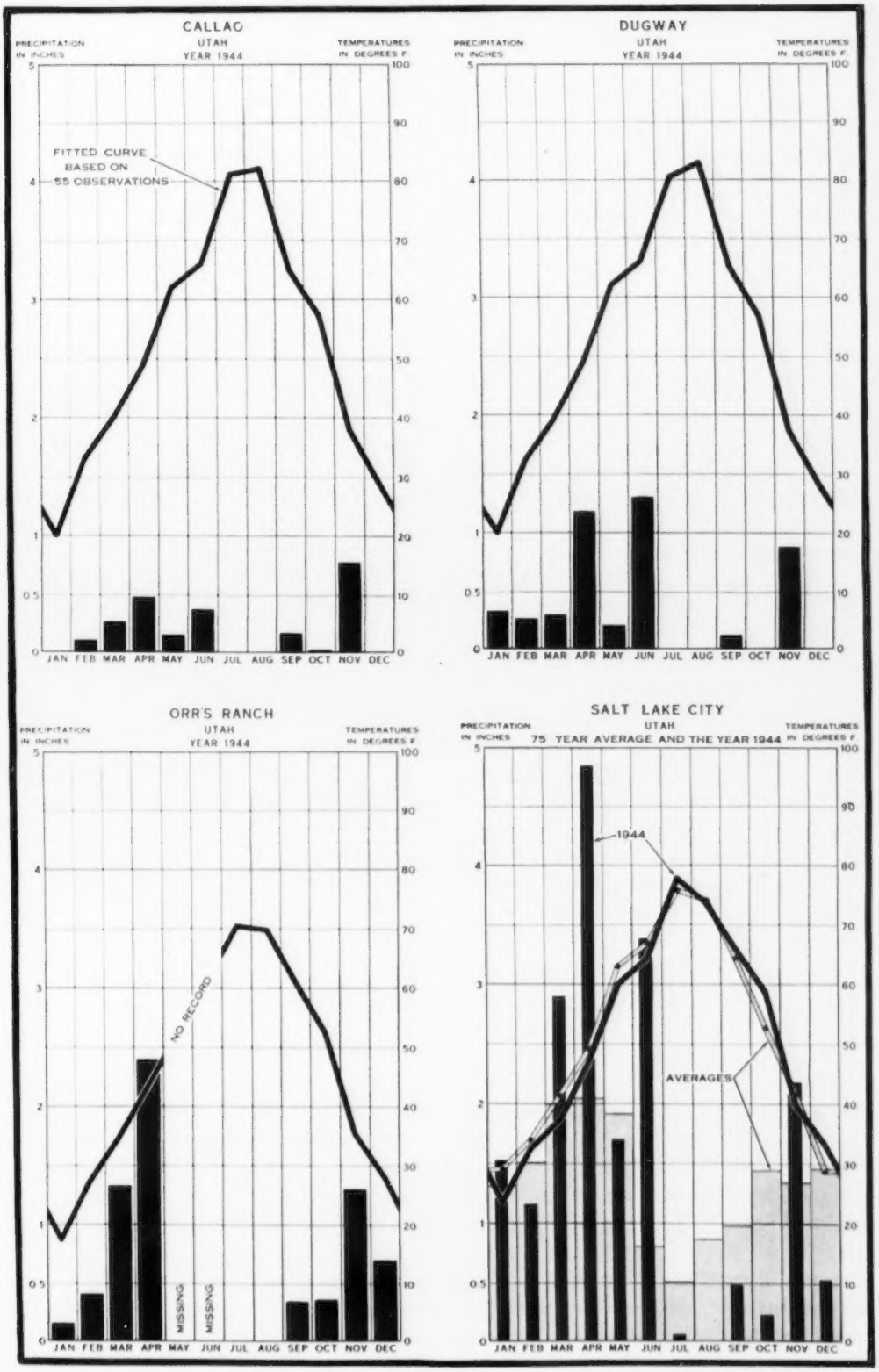

FIGURE 5.—Climatic charts for the year 1944 for Callao, Dugway, Orr's Ranch and Salt Lake City, with the 75-year average for Salt Lake City included. Data from U. S. Weather Bureau; Chemical Warfare Service; and Dan T. Orr.

Because of prevailingly low, relatively low, humidities and bright sunshine, neither extremely high temperatures sometimes recorded in summer, nor very low winter minimum temperatures, are usually uncomfortable. Large diurnal temperature range, exceeding twenty degrees in summer at some stations, brings marked relief, even on the hottest days, shortly after sundown.

MINERAL RESOURCES

Although the most plentiful and most obvious mineral resource of the Dugway area is salt, exposed on the surface for many square miles of salt flats (Figure 9), its present and future economic importance is practically nil, for purer deposits, more easily worked, are present closer to transportation and markets.

Small quantities of potash salts in the old lake deposits has led to establishment of a local potash industry near Wendover (Figure 1). The potash is also found in salt flats of the Dugway area, and in well brines under clay flats.

Prospecting in mountains in and near the Dugway area has disclosed a large number of mineral deposits, most of which have not been worked extensively as yet. Present indications are that the Stansbury, Cedar, and Onaqui Mountains, composed of Paleozoic limestones, partly metamorphosed, and containing some small igneous intrusions, contain no minerals of commercial value at present prices, although dolomitic limestone has been produced from the Stansbury Mountains near Grantsville (Figure 1). Small mineral veins, producing lead-zinc sulphides or iron-copper sulphides, with small quantities of gold, have been found near Johnson Pass ("Pass," Figure 1), but have not been commercially productive.

Small quantities of copper sulphides and carbonates, with traces of gold, have been uncovered in veins adjacent to small intrusions on the west side of the Simpson Mountains. Attempts to work them, during World War I, were financially disappointing.

In happy contrast, the Dugway Mountains, a faulted complex of paleozoic sediments, multiply intruded, contain several strongly mineralized areas. The northeast flank of the range has intermittently produced small amounts of lead-zinc-silver ores, largely sulphides and their oxidation derivatives; and of copper-gold ores, also largely sulphides. Initial production was in the 1880's, and the deposits have been worked at a small profit intermittently ever since. The northwest side of the Dugway Range is occupied by a deep narrow trench, locally known as Kelly's Hole, which is underlain by a large porphyry intrusion, containing small amounts of copper, and bordered by a series of mineralized faults, containing much "high grade" copper, mostly in the form of carbonates. They are believed to give way to sulphides at no great depth. Dimensions and content of the ore body here suggest that it is "another Bingham." To date, higher grade ores in bordering mineralized zones only, have been exploited (Figure 10).

Toward the southern end of the Dugway Range, near its junction with the Thomas Range, small quantities of topaz have been found in conjunction with rhyolitic intrusions. It is probably a northward extension of the Topaz Mountain intrusion, a famous gem site. Some rather remarkable geodes, of interest to collectors, have been exposed on the west flank of the Dugway Range, where they have accumulated in placer-like deposits, as a result of wave action in ancient Pleistocene lakes.

North of the Dugway Range is Granite Peak, a complex ridge composed of multiply-intruded schist, which has

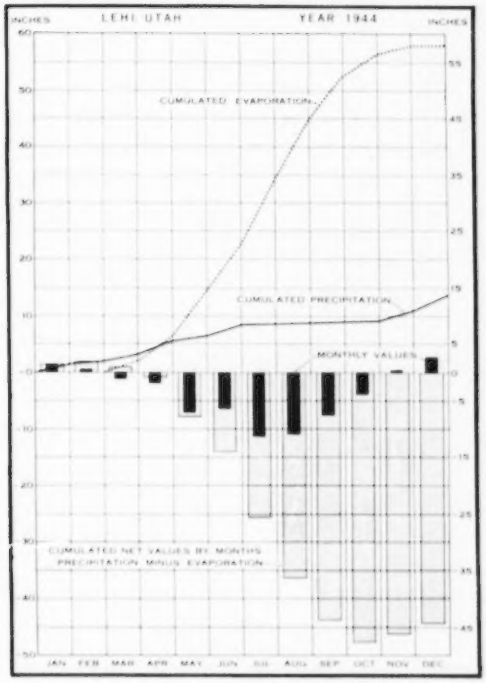

FIGURE 6.—Rainfall and evaporation values, by months, for the year 1944, as measured at Lehi, Utah.

a striped appearance from a distance. Granite Peak, once an island in Lake Bonneville, is a typical *inselberg*, or island mountain, with its base buried under gently-sloping pedimental deposits, and the sides deeply furrowed by relatively recent flood erosion. At the south end of Granite Peak is a small black hill, locally known as Sapphire Mountain, which is composed of black and extensively-metamorphosed limestone. Small sapphires, of no commercial value, are occasionally found in vugs in the area. The northeast part of Granite Peak, at the base, is composed of felsite, with pegmatite dikes; and the northwest side is an almost solid pegmatite. General appearance of Granite Peak, and its relation to other features, is shown in Figure 11.

Mineralized zones on the north side of Granite Peak contain lead-zinc sulphides, with some silver content, and iron-copper sulphides, carrying some gold. There was some commercial production from the area prior to and during World War I, but costs of haulage prevented profitable operation in non-emergency times. Mica and beryl, contained in the massive pegmatites on the west side of the peak have excited considerable interest, but are not commercially workable, at present, even at wartime prices.

Wildcat Mountain, northwest of the area under consideration, is producer of commercial fluorspar and mineral specimens of interest to the collector.

SUBSURFACE WATER

As a result of long-continued shallow drilling by the U. S. Grazing Service, and extensive deep drilling by various military organizations during the recent

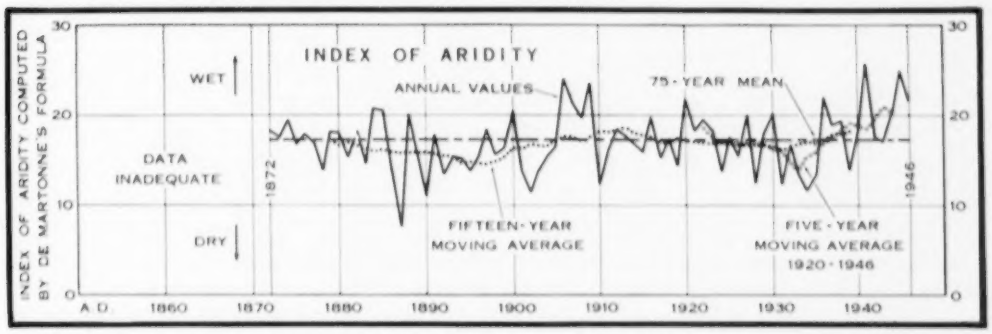

FIGURE 7.—Index of aridity for the Salt Lake area, as computed from official temperature (Salt Lake City) and rainfall (Great Basin division of Utah) figures, by De Martonne's formula. Note recent trend toward lesser aridity.

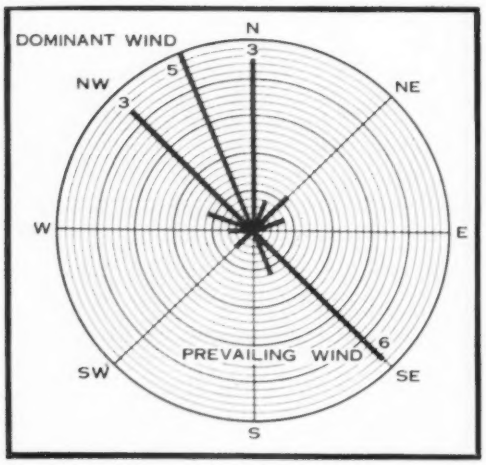

FIGURE 8.—One-day wind rose, for the two-meter level at Dugway, showing contrast of prevailing and dominant winds.

war, an extensive and surprisingly complex array of buried aquifers was discovered beneath the Dugway area. Wells which penetrated to depths of about 300 feet below the surface (drill at about 4,000′ MSL) encountered small quantities of strongly-mineralized water, containing, in most instances, iron, fluorine, and potash. In a few instances the water was warm, and chemically similar to that found in hot springs at Fish Springs and Fumarole Butte (Figure 1). The water, which is not potable, is also unsuitable for agriculture, and has no use except as a cathartic.

At depths between 200 and 300 feet below the surface, and isolated by beds of laminated impervious lake-bed clays, lies an extensive and thick boulder bed which carries great quantities of cool potable water; it forms the major aquifer of the area. Its known extent, as determined by numerous well logs, and verified by local geologic structure, is shown in Figure 12. It should be emphasized that the limit of the area shown is the limit of present knowledge, and not necessarily the limit of the aquifer. Water from the aquifer rises to within about fifteen feet of the surface in most wells, and as much as 200,000 gallons can be pumped from a single well (6″ casing) daily, for several years, without measurable drawdown. Several such wells were operated in Government Wash, north and east of Camelback Mountain, for several years during World War II. The water has a high fluorine content, but is apparently suitable for long-continued human consumption. (The writer drank this water for 46 months without any detectable harmful results.)

The aquifer is similar in stratigraphic and topographic location to similar aquifers in other parts of the Salt Lake Desert, as determined by the U. S. Geological Survey. At the present time, it is not certain whether it is a discrete aquifer, isolated from the others, or whether there is a buried connection, so that all of them are hydrostatically related. Constancy of the water level in wells, even with quite heavy pumping, indicates that the aquifer is considerably larger than is indicated by the present map (Figure 12).

It is notable that, although this aquifer is almost 200 feet below the level of Great Salt Lake, the water in it is sweet, and remains so even after pumping.

At about 4300 feet above MSL, and sealed on the top by a layer of laminated

FIGURE 9.—Salt flats north and west of the Dugway Mountains. These deposits, composed of impure sodium chloride, mixed with varying quantities of kaolin and bentonite, are without present commercial value, due to impurity and isolation from markets and transportation.

clay, a sand horizon, carrying saturated brine, is found in centers of larger valleys of the Dugway area. Where the seal of bentonitic clay is broken, the brine rises nearly to the surface, and wells up over the surface after very heavy rains and in the spring, damaging many types of vegetation. Several test holes showed that the brine was contained in sand-filled channels in old lake-bed clays, was overlain by a bed of *yeso* (a white, air-hardening marl), and the whole was overlain by younger laminated lake bed clays containing so much bentonite that small breaks and fissures in it are "self-healing." The brine horizon makes difficult or impossible the raising of any commercial crops on parts of the valley floor, and effectively prevents establishment of deep-rooted natural vegetation in many places. Relation of the brine horizon to other features of the area is shown in Figure 13.

In many pedimental areas, close to the bases of mountains, where considerable thickness of sediments has accumulated atop clay flat deposits, shallow wells tap small natural reservoirs, and from the "porosity storage" enough water is pumped by the U. S. Grazing Service to accommodate annual sheep drives through the region. A shallow well in the sediments choking the mouths of most of the canyons in the area will produce enough water for occasional range use.

FIGURE 10.—Kelly's Hole, a fault-bounded depression in the Dugway Mountains. Beneath the low central area is a large mass of copper-bearing porphyry. Along both sides are faults, which contain fairly high-grade copper ore. Note Bonneville shoreline in right center.

Recharging of the major aquifer, and of some of the smaller natural "porosity" reservoirs in the area explains why most canyons in mountainous parts of the area carry small flowing streams in their upper reaches, and no water farther down. When the stream flows in bedrock, no water is absorbed; but when the canyon floor is composed of stream deposits and the upper parts of pediments, water soaks in, eventually finding its way into one or more of the buried aquifers. Only when rate of flow exceeds rate of absorption does the stream carry water beyond the recharge area. General arrangement of pertinent features, as they apply to the Dugway area, is shown in cross-section in Figure 14. Although it applies specifically to the major aquifer, it presents a fairly typical case, applicable with slight modifications to many desert areas.

FIGURE 11.—South face of Granite Peak, as seen from the north flank of Dugway Mountains. The small dark ridge at left is Sapphire Mountain, composed of metamorphosed black limestone, as is the stack, at extreme right, a part of Dugway Range. The western outlier of Granite Peak, in the far left distance, is composed almost entirely of pegmatite. To right of the peak, on the horizon, is Wildcat Mountain (Figure 1). Note salt flats in left center and left distance; pedimental deposit in near center and at base of Granite Peak; and ancient beach, of Provo age in right foreground.

Although the major aquifer, and most minor aquifers, are fairly well isolated by beds of laminated clay, all water-bearing beds leak slightly, particularly

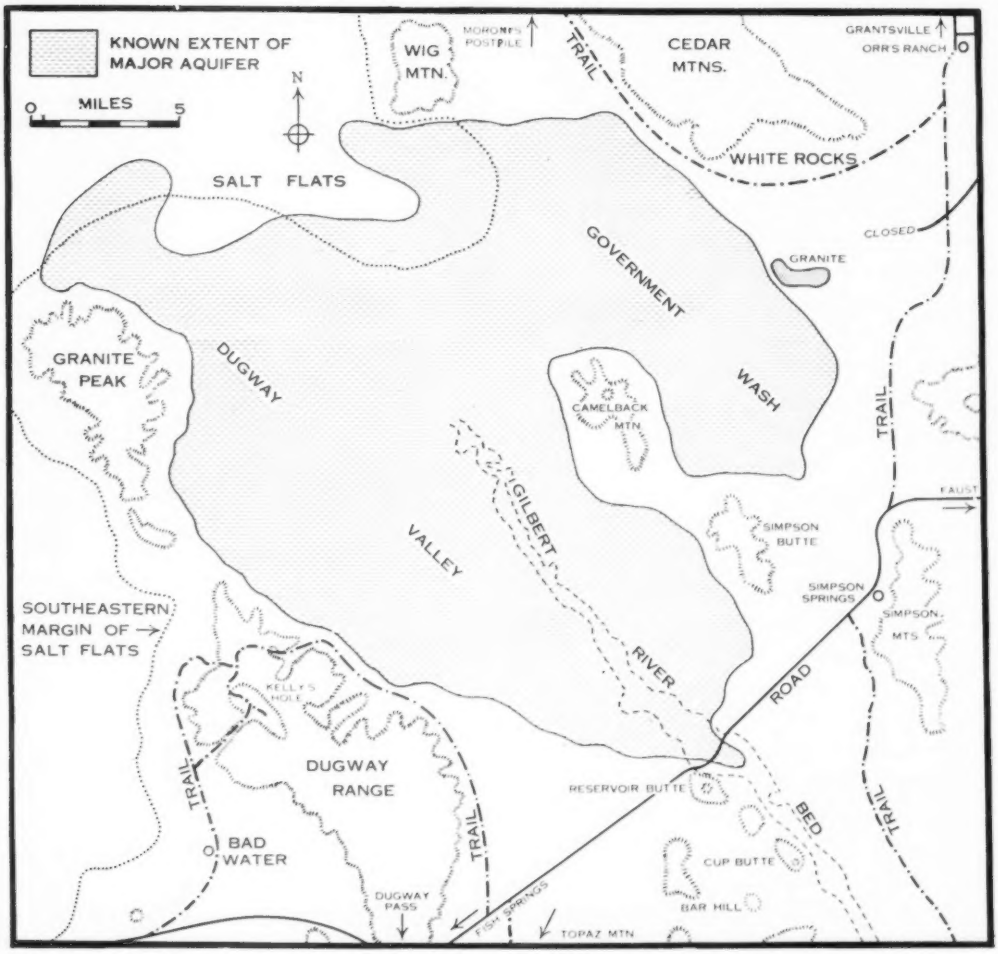

FIGURE 12.—Map showing known extent of major aquifer, from 200 to 300 feet below the surface of Dugway area. Quantity of this water, contained in a porous boulder bed, is very great.

in vicinity of relatively recent earthquake cracks, where springs are sometimes found. Because of the leaks, surface vegetation is not always in accord with regional rainfall distribution. In general, a leak from the brine horizon will produce a barren area, usually crusted with salt; while a leak in a fresh water aquifer will support lush grass growth in the middle of an area of gnarled sage and greasewood. Because of the bentonitic nature of the clays of the area, most leaks eventually "heal," and vegetative changes they cause are only temporary.

PRESENT ECONOMIC ACTIVITIES

A casual visitor to the Dugway area is likely to form the opinion that there are no economic activities there; that the region is uninhabited; and that perhaps it is uninhabitable. More careful investigation, however, shows that at least twelve ranches in the area are occupied for major parts of each year; and that mining activities, although on small scale, employ from ten to twenty persons most of the time. Both mining and ranching activities vary in intensity, not only seasonally, but in response to price fluctuations.

Although neither ranchers nor miners showed signs of great wealth, all were equipped with "good boots and good rubber," and their buildings, in most instances, were well maintained. Under present conditions, even though the area is not densely populated, and local opportunities are few, there is no indication that a "rural slum" is developing.

In addition to the more or less permanent residents, the area is visited twice yearly by sheepherders, during spring and fall drives from winter range, usually in southern Nevada, to summer range, usually in higher parts of the Wasatch Mountains. It was to expedite the drives, and to reduce stock losses, that the U. S. Grazing Service drilled numerous shallow wells adjacent to major trails in the area.

POSSIBILITIES FOR FUTURE DEVELOPMENT

At present (spring, 1948) national, continental, and world supplies of food (particularly meat), copper, lead, and zinc are definitely, and sometimes critically, short. It appears that the shortages will continue at least until new sources of supply are found and brought into production.

The Dugway area is already a minor producer of meat, copper, lead, and zinc. During wartime emergencies, when prices were raised, or subsidies paid, such production was rather profitable. At present, only meat production "pays off."

Current local opinion concerning the area is usually expressed vociferously in terms of "millions of dollars," "millions of acres," "build a dam," etc. Exactly where the millions of dollars are coming from, or what will be impounded by the dam, is not made clear. Certainly a desert area of this type presents marvelous opportunity for the expenditure of large amounts of public money, on an "operation rathole" basis.

Careful consideration of potentialities of the area indicates that about half of it is without economic value, now and in the foreseeable future. During World War II, much of the worthless land was used as a proving ground for experimental munitions (Dugway Proving Ground) and guided missiles (Wendover Field). Because much of the land has no other value, its continuance as a proving ground and test area seems advisable.

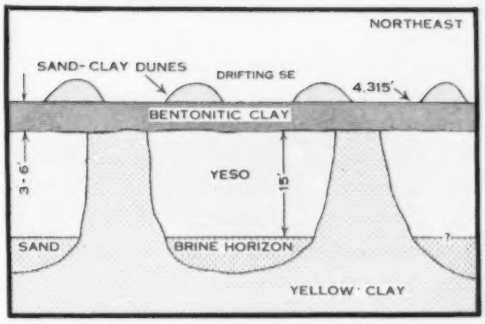

FIGURE 13.—Stratigraphic section showing relation of brine horizon to near-surface sediments in Dugway Valley.

Carrying capacity of local rangelands can be increased by a factor of at least two, by expenditure of relatively small amounts of money and labor. Chief needs at present are more water, and more winter feeding. A relatively small extension of the present Grazing Service drilling and pumping program will supply the necessary water; and some careful damming and ditching of relatively fertile, but now arid, bottom lands, particularly in parts of the Gilbert River Bed (Figures 1, 4, 12, and 15), will augment the grazing area considerably. If, and when, relative meat prices increase, carrying power of the local range could be at least trebled, and perhaps quadrupled by use of pump irrigation. At present prices, such expansion of the range would be unprofitable.

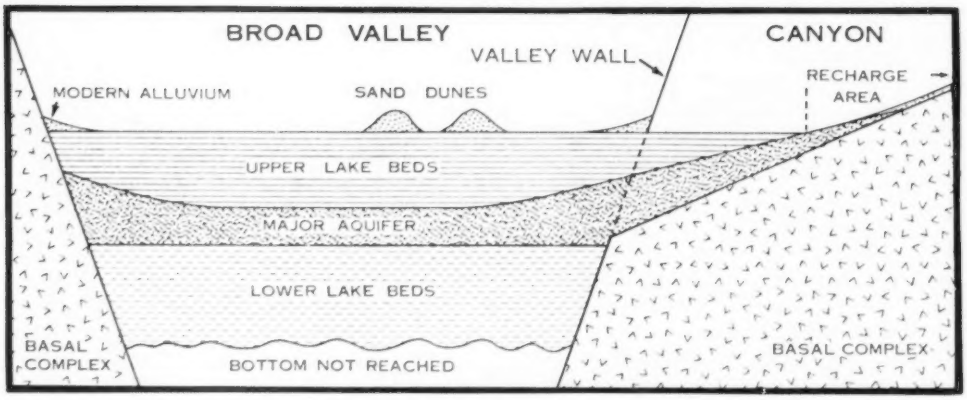

FIGURE 14.—General structure of the Dugway area, showing relation of lake beds, aquifer and valley walls.

A very small part of the Dugway area, perhaps five square miles in all, is suitable for raising commercial crops, by use of pump irrigation, using the major fresh-water aquifer (Figure 12) as the principal water source. Chief obstacles to greater extension are the brine horizon under parts of the area (Figure 13) and compact saline clay soils on the valley floors. It would be entirely possible to subdrain the area, by means of a ditch forty feet deep and fifteen miles long, but such a project would be so expensive that the total income from crops raised on the reclaimed land would probably not pay interest on the investment.

Commercial farming of pediment lands in the northern part of Skull Valley (Figure 1, between Orr's Ranch and Filot Rock), using water impounded during wetter months in relatively small reservoirs, has been practiced for more than half a century, and has supplied not only "cash crops," but winter feed for stock. Such operation has been financially successful, and similar procedures, on similar soils in the Dugway Valley, using pump irrigation, should likewise be successful. Extension of this type of agriculture onto the less-productive soils, however, may lead to lowered overall profits, waste of water, and eventual development of "rural slums," of which there are already too many on margins of the Great Basin deserts.

Mining development seems probable only in the Dugway Mountains and at Granite Peak. Chief obstacle to profitable mining in the area to date has been the very high cost of hauling unconcentrated ore forty or more miles to the railroad, and of hauling in all supplies, including drinking water. As result of recent drillings, it is apparent that sufficient water can be obtained from local wells, at no great cost for pumping, to permit local concentration of ores, with consequent marked reduction in ore haulage costs. This is roughly equivalent to increasing value of the ore by several dollars per ton; requires relatively small capital investment; and seems to make certain expansion of

FIGURE 15.—Fertile bottom land, capable of irrigation by relatively inexpensive ditching and damming. With slightly more water, such areas become excellent range land, and with more water and labor, can be converted to productive crop land.

mining activities in the area in the near future.

Exploitation of the large low-grade copper deposit under Kelly's Hole (Figure 10), is still problematical, and will require not only large amounts of capital, but construction of either a hard-surface road or a railroad, approximately forty miles long, before large-scale production is possible. Data now available indicate that production from this low-grade ore body is not likely to be economically possible for at least another generation.

If mining, range, and agricultural developments in the area can be properly synchronized and integrated, without having to support a large parasitic bureaucracy, profits from all operations can be markedly increased by elimination of much food-hauling and labor transport.

CONCLUSIONS

Present information indicates that the Dugway area of Utah is likely to increase markedly in economic importance in the near future, as water, mineral, and soil resources known there are more fully utilized.

A relatively slow and conservative expansion of range and agricultural areas, on a "pay as you go" basis, appears desirable. There is considerable danger, in the area, of over-expansion of both rangelands and irrigated farmlands; with resultant development of a poverty-stricken community of submarginal farms, with a "tobacco road" standard of living, hopeless indebtedness, and resultant wastage of natural and human resources.

Increased output and increased profits from local ore deposits of higher grade should be expected within the next decade, as shipment of raw ore is supplanted by shipment of ore concentrated close to the mines, using local water, from wells, in the milling process. Ultimate exploitation of large reserves of low-grade copper ore is to be expected, but not in the very near future.

About half the area is economically worthless, and no commercial utilization of this portion should be attempted.

FLORIDA'S CLIMATIC EXTREMES: COLD SPELLS AND FREEZES

Sigismond deR. Diettrich

FLORIDA'S climate is the product of its shape, location, and its land-sea relationships. The State consists of two distinct parts: one is the southward projecting peninsula comprising about two-thirds of its area, the second is the narrow westward stretching coastal belt, the Mainland. A diagonal zone extending from the St. Johns estuary to the Gulf Armpit divides these two parts which form two almost equilateral sides of a triangle based upon Pensacola and Cape Sable, with its apex at Fernandina. Due to this shape the Peninsula is progressively removed from the continental land-mass resulting in a successively decreasing continental influence upon its climate.

Though lying in the sub-tropical desert fringe between northern latitudes 31° and 24° 32′, Florida's climate is far from being a desert. Being located on the southeastern corner of a considerable land-mass where strong monsoonic influences are felt, Florida has a pleasant, cool, dry winter and a warm, humid summer. The annual precipitation ranges from a maximum of over 65 inches occurring on the two extremities of the State to a minimum of less than 46 inches in the Gulf Armpit. The low keys and the southwestern corner of the Peninsula are even drier than the Gulf Armpit. Key West has only 38.36 inches of annual precipitation. The warm season is the rainy season. Most of the rain falls in heavy afternoon showers of short duration lasting usually not longer than one and a half hours. Rain occurs on the average every other day during the four summer months. These thundershowers cut down the temperature extremes and seldom does temperature rise to or above 100° F. These usually occur either just before the beginning of the rainy season in June, or just after the close of same in September. Generally speaking the driest months are November and April. The winter precipitation which occurs mainly in the far western part of the Mainland is mainly cyclonic in origin. It becomes successively lighter toward the southern tip of the Peninsula, ranging from 25.43 inches in Molino, Excambia County to 8.58 inches in Key West for the five winter months of November to March. The Mainland extends into the belt of regular cyclonic activities but most of the Peninsula lies beyond the main tracks of cyclones, which explains the great difference in the amount of winter precipitation. Not only is the amount of precipitation light on the Peninsula during the cool months, but also long periods without rain may frequently occur. Since most of the agriculture on the Peninsula is carried on during the winter, these dry spells may make it necessary to irrigate the fields, especially in the well-drained, hilly sections.

Due to its peculiar shape, no part of the State is further than 60 miles from either the Atlantic Ocean or the Gulf of Mexico, therefore marine influences are dominant. These express themselves in the cooling effect of sea during summer and in its warming effect during winter. Thus the highest and lowest temperatures usually occur inland. The marine influence is also

expressed in the high precipitation of Florida. The average winter temperatures are mild, ranging from 52° F., in the northwestern corner of the State to over 70° F. on the Keys. The temperature gradient in January is 15° on the Peninsula. The summer temperatures are remarkably uniform over the whole State ranging between 79° F. and 84° F. during July. The maximum temperature on record for the Mainland is 107° F., for the Peninsula, 104° F. These high temperatures occur infrequently and never last longer than a few hours. As a matter of fact the general run of temperatures during the summer is more moderate than that of the Mississippi Valley. Some unpleasantness is caused by the high humidity of the air. But even here the noontime humidity ratio is about the same as that of the Middle West. Convectional showers usually cool the air. Another important consideration is the fact that the nights, with very few exceptions, cool off to such an extent that one can sleep and rest comfortably. Thus the summer season is by no means intolerable, especially if proper adjustments are made to the climatic conditions, both with reference to clothing and in diet.

The same factors which are responsible for Florida's climate bring about the extreme weather conditions of the State. Being attached to the large land mass of North America and being surrounded by warm bodies of water, strong continental influences may envelop the State, especially during the winter season. When these conditions occur Florida suffers from "cold spells" or "freezes," generally termed as "unusual weather." On the other hand the State's southeastern location on the continent and in the Trade Wind belt exposes Florida to the destructive influences of tropical hurricanes. The narrow peninsular shape of the State makes it vulnerable to these strong oceanic storms which may invade the land from three directions bringing destruction by wind, rain, and tidal waves in their wake.

Since both the cold spells, freezes, and hurricanes occur during the economically most active season of the State they may spell financial ruin to the people of Florida. Therefore it has become necessary, (1) to investigate how frequent are these extremes of Florida weather, (2) to find out what measures can be taken to mitigate their destruction and lessen the financial losses, and finally, (3) to learn how these natural calamities have affected the growth and development of Florida. In this article the discussion will be limited to the cold spells and freezes.

COLD SPELLS AND FREEZES

Winter to the people of peninsular Florida means the busiest season of the year. The beaches and lakes teem with tourists who come to enjoy their precious vacation time under the Florida sun. Equipped with bathing suits, shorts and play-suits these people are seeking escape from the leaden skies, snow and freezing weather of the rest of the country. It also means bustling activities in the fields, plowing, seeding, cultivating and harvesting fresh vegetables, picking and packing citrus fruit for northern urban markets. The weather is clear, sunny and warm. Yet every now and then the skies become overcast with dark, grey clouds, followed by a heavy downpour and cold, clear weather. Northern winter has invaded Florida bringing along a cold spell.

Even on Mainland Florida winter means only a cool season with expectation of only a few cold waves and a relatively short period with temperatures averaging below 60° F. The

average length of the frost season, i.e. the period between the first killing frost in fall and last killing frost in spring, is a good indicator of the length of the cool-cold season. On the Mainland this period varies from 111 days in the deep interior to 39 at Cedar Keys. Here cold spells occur regularly and the exceptional case is the one when they are absent. In Jacksonville, of the 48 years of observation only three have been free of minimum temperatures of 32° F., on the other hand only eight years had over ten such days, with fifteen freezing days as the maximum. Marianna has no record of being frost free, here the days with 32° F. minimum temperature or below range from 12° F. to 70° F. with almost half of the years having between 25 to 30 such days.

In contrast to the conditions found on the Mainland, on the Peninsula the situation is just the opposite. In Tampa, of the forty years' data only half record freezing temperatures with only one year showing eleven days with below freezing temperatures, the majority have only three or less such days. Hypoluxo, on the lower east coast, had only on one-fourth of its winter days freezing temperatures, with three days as a maximum. In the case of Miami, of the 36 winters' record, only seven years had freezing temperatures with one freezing day for each year. Key West has no freezing temperature on its records, thus it is the only truly frost free part of the United States. The interior of the Peninsula resembles more the Mainland. Here days with freezing temperatures occur almost annually but there are only a few such days, ranging from one to eight as a rule. During winter the temperature gradient is 15° F. over the Peninsula.

The general picture of the winters of Florida is then as follows: the Mainland has regular cool to cold winters of two to three months' duration when freezing and lower temperatures occur, ranging from a few days along the coasts to a maximum of seventy days (Marianna, 1917/18), in the interior. Similarly in the interior of the Peninsula there are days with temperatures of 32° F. almost every year but hardly any with temperatures below 25° F. Along both coasts of the Peninsula less than half of the years have records of freezing temperatures with seldom more than three such days during one winter. The southernmost part of the Peninsula, Key West, is practically actually frost free.

Under these circumstances cold spells have quite different meaning in the various parts of Florida. Weather conditions which are normal in interior of the Mainland would become serious cold spells on the Peninsula. Therefore, when discussing these one has to bear in mind that the cold spell of a season does not represent uniform temperature conditions all over the State, but will bring conditions which are severe enough in every part of the State affected by them to be classified as such.

The other significant point is to what extent do these extreme temperature conditions interfere with human activities? Obviously where the economic activities, especially agriculture, are mostly carried on during the warm season or are of such nature that are not directly influenced by the weather, cold spells and freezes mean only human discomfort. Conversely, where economic activities are directly dependent upon weather conditions like the citrus, truck and tourist industries of the Peninsula, relatively minor cold spells of short duration can easily cause serious trouble, even complete ruin to the people. Therefore, cold spells and freezes differ not only in their physical qualities but also in their impact upon human life.

During the past twelve decades there were ten severe cold waves or freezes recorded in the annals of Florida, of which only two occurred before the establishment of the Federal weather warning system in the sixties. The dates of these are February 1835, 1857, January 1886, December 1894, February 1895, 1899, and 1917, January 1922, December 1934, and January 1940. The frequency of freezes is apparently increasing. The mild periods occurred from 1835 to 1857 and hence to 1886 giving 21 and 28 mild winter seasons between the three freezes. During the second half of the period discussed, the frequency of freezes has quadrupled and the longest period of seventeen mild winters occurred between 1899 and 1917. The 1894 and 1895 freezes occurred within the same winter season and they have become known by a single designation as the "Big Freeze." The shortest interval between freezes came between the Big Freeze and the freeze of 1899, which latter bears the distinction of being Florida's coldest temperatures on record. The temperature was near 0° F. over the Mainland, dropping to −2° F. at Tallahassee which is the lowest record in the State. On the Peninsula, however, the temperatures were lower during the Big Freeze than in 1899.

There are two features worth investigating. One is the apparent increase in number of severe cold spells during second half of the period under discussion. As a matter of fact that is not the case. First, scattered records show quite a number of cold spells in addition to the more severe 1835 and 1857 freezes, e.g. snow fell in Appalachicola in February 1842, 16° F. was recorded "about" 1850. Second, the memorable effect of the freezes results from the destruction of crops. As long as general summer field crops and cattle raising were the economic mainstay of the Floridians, aside from human discomfort, the cold waves caused limited damage. When, however, citrus and winter vegetable production became the chief source of agricultural income, then cold spells and freezes assumed added importance as factors in economic life of the State. The shift from the old type field agriculture to modern fruit and truck farming started to take place in the early eighties, since which time the people of the State have become more aware of the significance of cold spells and freezes. As a result, accurate records are kept and the people are better informed about these. Of course the material losses suffered by the people are constantly on the increase proportionately to the general expansion of the citrus and truck farming enterprises. Thus the severity of the cold spells did not increase, neither are they more numerous than before, but their influence upon people and their activities has been intensified proportionately to the expansion of Florida's population and the spreading of citrus culture and truck farming.

The second feature of interest is that only the minority of the freezes occurred during the average coldest month of the year, January. Actually February had more freezes on record than any other month. Furthermore, the month in which the freeze occurs is not necessarily the coldest in the year, nor has it the lowest average temperature for that month on record. More often than not, either preceding or following the freeze, there are enough warm days to neutralize the low temperatures of the cold spell. The freeze of 1940 was an exception to this generalization on two accounts: first, it occurred in January, second, it was not only the coldest month of the year but also the coldest month since State records were begun (1891). The mean temperature

was 49.7° F., which is 9.3° F. below normal and 2.6° F. lower than the record of previous coldest January and even 2.1° F. colder than the previous coldest month, the February of the Big Freeze.

Thus the conclusions can be drawn that first, though severe cold spells and freezes are not annual features of Florida's weather, yet they are infrequently but periodically recurrent events which have to be considered both in Florida's agricultural and tourist industries; second, that the greatest probability of their occurrence comes during the month of February.

The physical factors responsible for the cold waves are found in the general circulation of the air-masses as influenced by land and sea relationships. In this respect Florida's southern location is counter-balanced by the size and continuity of land-mass stretching from the Tropic of Cancer to beyond the Arctic Circle; the presence of the warm bodies of water; and finally, the lack of an east-west mountain barrier.

The size of the landmass of the continent of North America is large enough to intensify the winter high pressure center over the land, causing a vigorous outward flow of cold air carrying the conditions of the cold interior to the coast. The warm bodies of water tending to reduce pressure over them increases the pressure gradient and thus accelerates the outward movement of continental air masses. Furthermore, the wide expanse of water bodies, especially the warm Gulf acts as a rejuvenator of cyclonic disturbances which bring in their wake the cold anti-cyclones. Mitchell noticed in 1917 that "cold waves are of shallow depth; that a transverse barrier, say 8,000 or 10,000 feet high, extending from the South Atlantic to the Plains States, would materially affect their southward sweep." The lack of such a barrier of course is just as responsible for the Florida freezes as the other two factors discussed.

The atmospheric conditions conducive to the occurrence of cold spells are: a strong anti-cyclone occupying the Central Plains as far south as Oklahoma with barometric pressure above 30.40 inches and moving southeastward in the wake of a cyclone with a depth of pressure of 29.90 inches or lower moving generally along the Atlantic in a northeastern direction. The steeper the pressure gradient the more severe the cold spell. A pressure gradient of one inch may result in a drop of 20° F. of temperature, of 0.6 inches in 10° F. It is in this phase that the warm Gulf of Mexico and the Gulf Stream play such an important role. It has been noted that the majority of the cold waves were preceded by long periods of abnormally dry weather. Such was the case in 1917, 1928 when seven consecutive dry months, and in 1934 when five such months preceded the cold wave. The last cold spell (1940) occurred during a normal precipitation regime. The draught of course further intensifies the losses. Another important factor appears to be a snow cover of some depth and duration in Alabama and Georgia which affects adversely the temperature conditions.

The cold damage is twofold, first the actual invasion of cold airmass damages the vegetation which is further intensified by the rapid loss of heat through radiation during the brilliantly clear and still nights, which are typical of the anti-cyclone. This second phase of the freeze is further intensified by dryness of the atmosphere and the resultant increase in evaporation. Local air drainage and soil conditions often cause great variations in the damage caused by excessive radiation. Rows of badly

damaged citrus trees may alternate with unharmed ones. Lakes, ponds, and slope of the land also cause great variation in frost damage. Thus only by studying local conditions can the extent of the damage be estimated and the appropriate measure of protection ascertained.

The human significance of the cold spells and freezes is tremendous. Since the cold wave comes in an inconspicuous fashion, unlike a hurricane, the seriousness of the damages caused by it is not fully realized. The Big Freeze caused undoubtedly the greatest financial loss to the State. It not only damaged crops and trees but wiped out the citrus and tourist industries of the State. During the 1893/94 season Florida produced over five million boxes of oranges, in 1894/95 the estimates were higher than those for the previous season but only less than half, 2.5 million boxes, were picked before the Big Freeze killed practically every orange tree in the State. The only area spared was the southwest shore of the Peninsula and a few isolated acres protected by water, such as a few hundred trees which remained out of the thousands standing before in Lake county. The freezing was so complete that the trees burst as the sap froze in them. The total loss was estimated at $75 millions. The only comparable catastrophe was the Miami hurricane of 1926 which caused a total estimated loss of $72.5 millions.

The result of the Big Freeze was the evacuation of the St. Johns Valley–Alachus County citrus and tourist belt. Both industries moved southward, and the Peninsula was opened up. Flagler on the east coast, Plant on the west were pushing southward in the quest of security from frost and freezes. The citrus industry learned a great deal about how to minimize frost damages. Instead of selecting flat areas the new groves were set in hilly, lake dotted areas, utilizing the moderating effects of water bodies and favorable air drainage conditions. Since the serious damage is caused by the loss of heat due to radiation, the firing of groves developed using either fat pinewood or smudge pots for creating a smoke screen to cut down on radiation and heating the groves. In collaboration with the Federal government frost warning stations were established to give advance notice of the frost hazard.

Similarly to the citrus industry, the center of tourism shifted from the Jacksonville–St. Augustine–Palatka–Ocala area to the lower east and west coasts and the lake area of the southern part of the Central Highlands. Finally, in order to bring the southernmost part of Florida into the economic life of the State, Flagler built the overseas railroad to Key West. That this adventure became an economic failure was not caused by lack of enthusiasm and interest but because it hardly had any economic justification. Thus as the result of the Big Freeze, which was big, not on account of being the coldest but because it caused the greatest financial losses to the people of Florida, opening up of the Peninsula was greatly accelerated. As far as agriculture was concerned, a much better adjustment to conditions has been effected, so that ultimately a disaster of the first order was turned to advantage.

The freezes since, have caused damages but nothing comparable to the Big Freeze. It was pointed out before that the freeze of 1899, while actually the coldest on record was less cold on the Peninsula than the Big Freeze. Furthermore, it could not have caused heavy losses since there was very little left to be damaged so shortly after the Big Freeze. The greatest loss since was caused by the 1940 freeze when the

damage was estimated at $20 millions which was small in comparison to the losses suffered by the Big Freeze or the hurricane damages. If, however, the losses suffered by crops alone are being considered then the cold spells are about as destructive as the hurricanes with hardly more potential protection from frost than from high winds and heavy rains.

Florida suffered from severe cold spells and freezes in the past and it shall do so in the future; in order to minimize these bad effects upon the economy of the State and the financial well-being of its citizens (1) the recurrence of freezes has to be accepted as a regular feature of Florida's climate, (2) every means should be used to learn more about the causes and behaviour of these cold waves, (3) every technical knowledge and technological skill should be employed in locating fields, in the selection of crop varieties best suited to local conditions, and in the actual growing and processing of the selected crop, (4) arrangements should be made by the growers and farmers to protect themselves against financial losses or even ruin by either, (a) carrying insurance against crop failure, or (b) providing for an emergency fund during the good years. If these basic principles would be uniformly accepted and put into effect the occasional cold waves and freezes could not spell again the economic ruination of sunny Florida.

BOOK REVIEWS

WEINDLING, LUDWIG. *Long Vegetable Fibers.* Manila, Sisal, Jute, Flax and Related Fibers of Commerce. Published by Columbia University Press. New York, 1947. Price $5.00. XVII and 311 pages.

During the recent war the quantity of available raw materials and possible new sources of supply for certain important industries became extremely significant or even critical. This work by Weindling was written to present commercial aspects of the long vegetable fiber industry for national planning in war or peace, and to furnish additional statistical and technical information.

Students of the textile industries may use the book for supplementary reading or as a text on the subject for manufacturing methods required for the conversion of the fibers into various finished products as well as major problems relating to such conversions are taken up. Certainly persons engaged in some particular phase of the industry will be able to supplement their practical experience with knowledge of the general nature of the fiber industry. Persons interested in economic planning and commerce in general will find the publication a valuable source of assistance. Lastly, geographers will welcome the book for its account of growing and harvesting methods, countries of origin, and material on acreage, volume, marketing procedure and destination of output. One might wish that more than the one map, "Abaca Producing Regions of the Philippine Islands," had been included.

Although the author intentionally has devoted most of the book to a treatment of hard fibers because of their more important role in American industry, he has afforded the reader with excellent data on jute, flax, hemp, sunn fiber, and ramie. Woven through the book are accounts of working conditions, importance of each industry to the national economy and outlook for the future.

The book is well organized and indexed, statistical tables are complete, and reading is easy. It makes a definite contribution to its field.

H. J. W.

ROSEVEARE, G. M. *The Grasslands of Latin America.* Bulletin 36 of the Imperial Bureau of Pastures and Field Crops. Aberystwyth, Great Britain. Printed in Great Britain by William Lewis (Printers) Ltd. Cardiff, 1948. 291 pp.

The foreword, written by R. O. Whyte contains this sentence, "Works from many journals and hundreds of books and occasional publications, originally written in several languages by authors of very varied scientific standing, and covering all manner of ecological and economic conditions of management and production, are here brought together for the first time." The value of the book is expressed in Mr. Whyte's statement. Proof may be found in Chapter eight which contains a list of trees, shrubs and browse plants eaten by or fed to stock in Latin America, in the thirty-one pages of references arranged alphabetically by authors, or in the indices of authors, and of genera and species.

At first glance one is inclined to assume that the work treats the grasslands of Latin America as of four major types; namely, Type 1: Good Natural Grasslands (Chapter 2); Type 2, Cool Mountain Grasslands (Chapter 4); Type 3, Semi-arid Grazings (Chapter 5); and Type 4, Savannahs of hot climates (Chapter 6). However, such is not the case. The author has added to Type 1, descriptions of the grasslands of Entre Rios, The Magellan Lands, and the Pre-Andean Depression, as well as inserted, in Chapter 3, work by L. R. Parodi on the natural grazings in the Province of Corrientes, Argentina, and stock raising in the Argentine Chaco. The material contained in such borderline or transitional areas will prove of great worth to people specializing in Latin-American study, since the regions always have appeared as problem zones. Chapter 7 deals with the temporary ley. It gives an enlightening and scholarly account of how man has attempted to "provide the wanting elements through the cultivation of nutritive plants" for the better class of stock. A more complete story on Chile would be desirable, but Brazil and Argentina are remarkably well done.

The last five chapters stress conservation, animal and plant health, management and research. They are happy and welcome additions to the Bulletin, for the volume thus becomes of value to more readers than Latin-American specialists for whom the work seems a must.

H. J. W.

SMITH, T. LYNN. *Brazil: People and Institutions.* Published by Louisiana State University Press, Baton Rouge. Third Printing, July, 1947. XXIII and 843 pages.

The author states in the Preface that his purpose has been "to organize, analyze, and interpret the materials on Brazilian demography and social institutions." He has succeeded admirably. However, the reviewer would suggest that adequate background in Brazilian geography and history is necessary before reading this work on Brazil, in order that the reader may grasp the full scope and meaning of such a monographic work as the volume proves to be.

Part II, Cultural Diversity; Part III, The People; Part V, Relations of the People to the Land provides the graduate student and researchers with ample and profound statements for digestion and absorption.

The complete and interestingly presented material on standards of living and institutions indicate the exhaustive research by Mr. Smith in supplying this first major production to come from Louisiana University's Institute of Population Research. More than fifty photographs,

seventy-eight tables and twenty-nine maps enhance the value of the book. A glossary of Portuguese word meanings is a welcome adjunct. In itself the bibliography of fifteen pages makes the book a necessary possession of persons interested in Brazil and her problems.

The work will make both North Americans and Brazilians indebted to Mr. Smith for his masterful handling of such a complex subject.

H. J. W.

Wilson, Charles Morrow. *Liberia.* Published by William Sloane Associates, Inc., New York, 1947. 226 pages. Price $3.75.

This book presents a vivid picture of Liberia, a small African country in which the United States has a special interest. American interest began early in the last century, when successive attempts to settle a colony of freed slaves on the western coast of Africa finally met with some success. But such memory of the country's origin might easily lead to an erroneous conclusion. As Mr. Morrow points out, fewer than 1500 American Negroes ever actually "braved the fever-ridden frontier called Liberia" and fewer than half of one per cent of present-day Liberians are descendants of American Negroes.

Following an introductory chapter characterizing Liberia in its African and world setting, a chapter deals with the major facts of the country's history. One reads of the difficulties encountered in carrying out what seemed like a simple project—the returning of freed slaves to a section of their original homeland. The story of the gradual amalgamation of the settlers and the native tribes into some semblance of a united country, the Republic of Liberia, is vividly told. So, too, is the story of the Republic's territorial losses to powerful neighbors. It was not until the little country obtained the backing of the United States early in the present century that Liberia can be said to have become definitely outlined and established.

The chapter on "Liberia Today" is good descriptive geography. The march of the seasons, the constant battle of the native farmer with the "bush," the predominance of rice among the food crops—these are a few of the highlights of the picture presented. Throughout, one is conscious always of the great contrast between Monrovia, the ocean front capital, and other portions of the more-developed coastal belt on the one hand and, on the other, the essentially unchanged interior. "In the backcountry the brief spans of cleared roads end head-on in blockades of jungle, and most of the river crossings still lack bridges."

The essentially native character of Liberia with all that this implies is emphasized further in the chapter "From the Tribes." One of the greatest problems in the evolution of the Liberia of today has been the working out of friendly relations with the great tribes of the interior. "The coördination and integration of the tribe with a republican government is gradually achieving success."

Four chapters dealing with Liberia's rubber industry are of particular interest to the economic geographer. In early decades of the century the place of Liberia's crops in world trade was still extremely uncertain. Its exports were much like those of its neighbors although less in volume—palm products, coffee, wild rubber, certain other tree crops, and occasional cargoes of gold, ivory, or skins. Prospects for any radical change seemed by no means bright. But a series of events in other countries was setting the stage for change in Liberia. British growers of rubber in southeastern Asia restricted the planting of *Hevea brasiliensis*, the greatest of the rubber source plants, in order to keep up prices. Plantings in the Netherlands Indies increased, so that finally the "Stevenson Scheme" of the British was dropped, but the attempt showed how much American consumers were at the mercy of the rubber producers of southeastern Asia. It was against such a background that Harvey S. Firestone, the pioneer rubber manufacturer, launched a campaign that was to bear fruit for Liberia. With the slogan, "Americans Should Produce Their Own Rubber" he began a search for new sites for growing Hevea rubber. He sent his eldest son, Harvey S. Firestone, Jr., to investigate various tropical areas as possible sites for rubber plantations, with the result that a plan was announced for the company to grow its own rubber in Liberia. Firestone announced that he had chosen Liberia because the country was "free of foreign domination" and "because of its friendly government and population, having strong natural ties with the United States." The new undertaking seemed colossal. How the various difficulties were overcome makes an interesting story to which Mr. Morrow does full justice.

There is no question but that Firestone's dream has materialized. By the date of Pearl Harbor, Liberia was producing more than twice as much natural rubber as all of the American tropics, and during the early years of World War II Liberia and Ceylon were the greatest rubber producing strongholds of the United States and her allies. Even before the War, rubber had become Liberia's chief export. By 1947 Liberia was producing between 15 and 20 per cent of the world's natural rubber and the country's total was steadily increasing. Along with the growth of plantation production of rubber has come a steadily increasing production by native farmers on adjacent lands. All in all it is a development which augurs well for the future of the little republic, unless, of course, synthetic rubber eventually crowds the natural product out of the market.

The last three chapters of the book seem like an anticlimax after the story of rubber. In "Liberia and Africa" the author discusses the role that Liberia has played in the history of the continent; follows by a chapter on "Liberia and Medicine" in which the practices of "folk medicine" in the Republic are considered as well as the contributions that modern medicine has made; and in a concluding chapter summarizes the future of the country, with particular stress on the future of education and of medical research.

To the geographer it seems unfortunate that no map appears in the book. The end pages might have been effectively used for this purpose. Also, the reviewer feels that the reader of "Liberia" might well get an exaggerated

idea of the importance of the rubber development, at least its importance to the average Liberian native. But these are minor points. The book is very informative and the style unusually clear and interesting. There is much good geography within its covers.

R. E. M.

Karig, Walter. *The Fortunate Islands: A Pacific Interlude.* Published by Rinehart & Co., Inc., New York and Toronto, 1948. Price $3.75. 226 pages.

Here is a book about American Micronesia which, though written primarily for the layman, will appeal to many a geographer as well. The title is a reference to Greek Mythology in which the "Fortunate Islands" were a group of islands in the Western Sea, inhabited by beings especially favored by the Gods. They were the "Isles of the Blest" where perpetual summer obtained. The name is as apt for Micronesia as for any place on Earth, far more appropriate than for Madeira and the Canaries to which it was sometimes applied by mediaeval mapmakers.

That the book is graphically and entertainly written is apparent from the following description of Bikini in Captain Karig's own words: "As tropical islands go, Bikini is to the white man's eye a beautiful ditto of hundreds of beautiful coral isles, but for all practical liv'ng purposes, which is the way the Micronesians looked at it, Bikini was a slum. In the days of the New Deal farm program it would have been called a submarginal place."

After dealing with Bikini in this vein and in considerable detail, the author goes on to describe Micronesia as a whole. There is a chapter that speculates upon the origin of the people themselves, and another that deals with the impressive prehistoric ruins of Nan Matal on Ponape. Other chapters follow, all excellently illustrated with photographs taken either by Captain Karig, himself, or by Photographer's Mate 1/c Vernon C. Gustafson, USNR. One chapter, entitled "Room and Board" describes native housing and native foods with enthusiasm. The chapter winds up with a collection of native recipes that will tempt the amateur chef. The recipe for Pe-rola, for instance, a thick pudding or macaroon-like cake, can be reproduced by the American housewife by using bananas, grated coconut, a little honey and a pinch of salt. Pe-rola native style is not at all bad if you have plenty of sugar to put on it. It was certainly the most interesting dessert that the reviewer encountered in seven weeks on Mokil, Eastern Caroline Islands.

So it goes; each chapter is crammed with interesting lore pertaining to native life and customs. On the whole, anthropology receives much more attention than does geography, probably from the fact that physical geography in Micronesia seems to be so largely repetitive and differences in cultural geography are not easily noted by a non-geographer. A few obvious errors have crept into the book. For instance "taro" and "arrowroot" are shown as synonymous whereas, they are different plants. There are also some erroneous ideas expressed about the agriculture of Mokil. But such slips are certainly excusable in a book that does not purport to be a scientific treatise in the first place and puts its emphasis upon entertainment. As such, the book is wholly successful.

That Captain Karig loves Micronesia and its people is obvious to anyone who reads this book. That the Micronesians reciprocated this affection was equally obvious to the reviewer when part of his own stay in Mokil a year and a half ago happened to coincide with the author's visit there. The people of Mokil were charmed with the Captain, as their gift of a full-sized sailing canoe amply indicated. A Mokil outrigger is truly a marvelous craft, beautifully and delicately made. No gift could have pleased Captain Karig more or could have better expressed the high regard that the people of tiny Mokil feel for the United States Navy and the nation it represents.

R. E. M.

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